



NYASALAND PROTECTORATE

Annual Report

of the

Department of Agriculture

1931





NYASALAND PROTECTORATE

Annual Report

of the

Department of Agriculture

1931

ZOMBA

PRINTED AND PUBLISHED BY THE GOVERNMENT PRINTER

NYASALAND.



UNITED STATES DEPARTMENT OF AGRICULTURE

Annual Report

Department of Agriculture

1881

STAFF LIST

Department of Agriculture

Director	W. SMALL, M.B.E., M.A., B.Sc., Ph.D.
Assistant Director and Agricultural Chemist	A. J. W. HORNBY, M.B.E., B.Sc., A.I.C.
Entomologist	C. SMEE, M.C., D.I.C., F.E.S.
Mycologist	R. LEACH, B.A., A.I.C.T.A.
District Agricultural Officers	F. BARKER, C.D.A.; E. LAWRENCE, N.D.A.
Senior Clerks	J. A. CALLOW.; J. A. A. CHANNER
Clerk (Temporary)	M. V. SMITHYMAN

Empire Cotton Growing Corporation

Cotton Specialist	H. C. DUCKER, B.Sc., N.D.A.
Assistant Cotton Specialists	W. L. MILLER; S. T. HOYLE, B.A.

Native Tobacco Board

Secretary	J. A. CALLOW
Agent	R. E. CLEGG, M.B.E.
Area Supervisors	R. M. ANTILL, M.C.; W. P. TYLOR
Supervisors	R. J. SANDERSON
	J. W. BURTON
	R. E. WILBRAHAM
	J. W. PRYOR
	F. F. SMITHYMAN
	R. E. JACKSON
	A. G. H. DU FRAYER
	A. B. CORMACK
	J. FOOT
	F. I. SCOTT
	G. D. N. BARTLETT

Report of the Director of Agriculture.

PART I. AGRICULTURE IN NYASALAND.

General.—The year 1931 began with a shortage of rainfall carried forward from the last quarter of 1930 but in January rains were excessive in amount, particularly in the Northern Province. February was more or less normal while March and April rains were short. Planting out was later than usual in certain parts and early root development was not as free as it might have been. As far as tobacco was concerned, conditions improved as the season advanced and the crop was of fair quality and yield. In the northern lake-shore area conditions were more or less normal while the tobacco-growing parts of the Southern Province had a normal season until March. In the tea belts of Mlanje and Cholo the rains were good on the whole but the dry months were very trying. At lower elevations March and April rains were inclined to be short and cotton in the Lower River which had a good start suffered from drought in the later stages of growth and ripening.

It cannot be said that 1931 brought an improvement in the economic conditions bequeathed by 1930 to producers. On the whole, prices continued to fall with the result that profits were eliminated and development was restricted. Sisal, cotton and rubber were most severely affected but producers of tea and European tobacco did not find much profit in their operations. Like other industries, agriculture is dependent on markets and both the farmer and the peasant, the one on a large scale and the other in his smaller way, are in business and are at the mercy of world prices. The present long-continued and severe depression may be capable of alleviation through fiscal preferences and the like, but, on the other hand, it may be expected to lead to changes in the present methods of production and distribution whereby production will be maintained at an economic level and effected at a minimum cost per unit of capital and labour. Over-production must therefore be avoided and the maintenance of quality will be more essential than ever. Government found it necessary to grant a temporary remission of a percentage of agricultural rents, but advances to tobacco planters came to an end with the finish of the 1930-31 season.

The following table gives the European acreages and production of the principal crops over the last three years. It should be noted with regard to tea, coffee and rubber that the acreages are not in full bearing.

	1929		1930		1931	
	Acre	Yields	Acre	Yields	Acre	Yields
Tea ...	8,866	1,744,176 lb.	9,686	1,904,000 lb.	11,414	2,193,296 lb.
Coffee ...	1,331	1,151 cwt.	1,256	1,286 cwt.	1,542	1,175 cwt.
Tobacco ...	19,269	5,128,256 lb.	17,481	6,508,768 lb.	13,482	4,168,528 lb.
Sisal ...	8,270	1,230 tons	9,296	1,305 tons	9,304	153 tons.
Cotton ...	1,219	738 cwt.	761	635 cwt.	225	159 cwt.
Rubber ...	1,330	157,584 lb.	1,405	115,248 lb.	1,500	—

The only native cash crops of importance at the moment are tobacco and cotton, and the figures of production of these crops over the last three years are shown below. The figures are given as *yields* but it would be more correct to label them as *amounts purchased*, especially in the case of cotton in 1931 when only No. 1 grade was bought. The tobacco figures are inclusive of leaf produced on Crown land and on private estates.

	1929 Yields (tons)	1930 Yields (tons)	1931 Yields (tons)
Cotton	3,505	5,448	2,477
Tobacco	3,881	4,233	3,519

The following table gives the amounts and values of agricultural produce and raw materials actually exported during the last three years. It shows in which directions decline of the principal exports was most marked in 1931.

	1929.		1930.		1931.	
	Quantity.	Value. £	Quantity.	Value. £	Quantity.	Value. £
Capsicum and chillies ...	3,309 lb.	111	10,205 lb.	301	1,098 lb.	14
Coffee ...	894 cwt.	3,239	952 cwt.	3,109	834 cwt.	1,988
Maize and maize flour ...	352,390 lb.	602	349,500 lb.	646	311,452 lb.	558
Potatoes ...	5,406 lb.	30	2,284 lb.	12	34,150 lb.	182
Tobacco ...	10,340,217 lb.	403,678	12,934,914 lb.	484,738	10,690,581 lb.	400,897
Tea ...	1,755,419 lb.	74,383	1,939,756 lb.	56,543	1,963,452 lb.	49,129
Beeswax ...	170 cwt.	1,024	157 cwt.	880	195 cwt.	1,092
Cotton (lint) ...	947 tons.	62,661	1,696 tons.	72,881	1,011 tons.	37,729
Cotton seed ...	863 tons.	1,726	1,620 tons.	3,239	628 tons.	1,257
Fibre ...	1,200 tons.	34,465	1,284 tons.	29,607	242 tons.	2,661
Groundnuts ...	—	—	1,216 lb.	7	1,100 lb.	6
Rubber ...	172,305 lb.	3,345	94,185 lb.	1,628	—	—
Strophanthus ...	5,961 lb.	888	8,146 lb.	1,222	10,581 lb.	1,587
Rice ...	200 lb.	1	—	—	2,176 lb.	10

Nyasaland was threatened with locust invasion during the second half of the year under review (invasion of the extreme north-west corner of North Nyasa by the migratory locust actually took place in January 1932), and steps were taken to acquaint all administrative officials and the inhabitants of the threatened area with the measures to be taken against the locusts and to advise the natives to supplement their graminaceous food plants with increased planting of root and other crops. A Bush Fires Committee was appointed to consider the important question of the bush burning that takes place annually. The committee regarded the burning in a serious light, that is, as a practice which is very harmful to the country and which must be controlled if extensive and irreparable damage to the natural resources of Nyasaland is to be avoided, and it therefore made recommendations involving educative work and changes in legislation.

The report of the Agricultural Adviser to the Secretary of State for the Colonies on his East African tour of 1930 was issued during 1931 and careful note was made of the criticisms and recommendations affecting this country. Several of them, indeed, had been acted on before the report was received and other matters await the extension of the work and staff of the Department of Agriculture.

The Entomologist represented Nyasaland at a conference of East African directors of agriculture at Amani in February and at a conference of directors of agriculture in London in July 1931. The former conference discussed matters of local importance such as the relation between the work of the East African Agricultural Research Station and that of the East African departments of agriculture, the lines of work adopted at Amani, quarantine of plant imports and import regulations, publications; co-operation, marketing, inspection and grading of produce, and native agriculture. The London conference discussed matters of wider significance and passed resolutions on the training of agricultural officers and subordinate officers, native agricultural education, the Imperial Agricultural Bureaux in the United Kingdom, plant introduction, plant imports, local advisory bodies, produce inspection, agricultural co-operation, animal husbandry, district registers, records of experimental work, and methods of field experimentation. The recommendations on the last three subjects have already been adopted and put into practice.

Tobacco.—Early irregularities of the season were corrected by good rains in January. February improved prospects in some parts but gave only dull and unfavourable weather in others. Much therefore depended on March, and a good recovery was seen in most districts and especially in the former Central Province. The European tobacco of the Southern Province ripened well and gave better quality than was expected. It was anticipated that the reduction of European acreages would enable every attention to be given to the general improvement of quality. Wireworm, cutworm, and yellow stem grub were troublesome in February and necessitated a certain amount of replanting, but over the whole season aphids and *nyerere* ants were the most prevalent pests. Mosaic and frenching (leaf curl) occurred, and there was a certain amount of angular leaf spot, frog-eye and drought spotting.

The acreage under European tobacco was reduced from 17,481 in 1930 to 13,482 acres in 1931 and production fell from 6,508,768 lb. to 4,168,528 lb. Of the latter total, 3,374,112 lb. was sold locally, 442,736 lb. was exported direct, and 351,680 lb. remained unsold or unsaleable. In 1930 European-grown tobacco amounted to 41 per cent. of the total weight exported and in 1931 to 39.3 per cent. The following table gives the total amounts and local values of tobacco exported in 1931. The figures are classified according to the method of curing and the 1930 figures are given for comparison. The flue-cured and air-cured leaf are produced by European growers and the bulk of the dark-fired leaf by native growers.

	1930		1931		Increase or decrease lb.	
	Amount lb.	Value £	Amount lb.	Value £		
Dark-fired	10,030,016	375,993	7,952,873	298,233	—	2,077,143
Flue-cured	2,866,569	107,310	2,590,253	97,134	—	276,316
Air-cured	38,329	1,435	147,455	5,530	+	109,126
	12,934,914	484,738	10,690,581	400,897	—	2,244,333

A further table gives a division of total tobacco exports into European-grown and native-grown and the percentages of the total pertaining to each class for the years 1930 and 1931.

	1930		1931	
	Amount exported lb.	Percentage of total	Amount exported lb.	Percentage of total
European-grown	5,303,314	41	4,201,399	39.3
Native-grown	7,631,600	59	6,489,182	60.7
	12,934,914		10,690,581	

The consumption of Empire tobacco in the United Kingdom has increased steadily over the last twelve years and it continued to increase in 1931. Between 1926 and 1931 the usings of Nyasaland leaf increased by nearly 3,000,000 lb. and in 1931 Nyasaland leaf cleared for home consumption reached the record total of 10,496,988 lb. an increase of 828,002 lb. or 8.56 per cent over 1930. Nyasaland is the principal supplier of colonial tobacco to the United Kingdom and, though its percentage of all colonial tobacco used is not increasing, its position in the home market as a whole has continued to improve. In other words, Nyasaland now provides about one-third of the total consumption of colonial tobacco and has therefore had its share of the increased demand.

Unfortunately it cannot be said that both flue-cured and dark-fired leaf have benefited equally and have increased in production and sale side by side. The fact is that European tobacco acreages have been declining since 1927. An uncertain market, unreliable climatic conditions, low yields, freights and falling prices are the reasons usually given for the decline, but it is pertinent to wonder whether the production of flue-cured leaf takes place in the most suitable areas and under the best agricultural treatment and conditions. Inasmuch as the future of the flue-cured industry depends on the demand for its product, this matter is of great importance to the European planter. It is hoped that the increased export of air-cured leaf in 1931 is significant. It will be of interest to know the reception accorded to it in 1932, but it has often been pointed out and it should be remembered that types of tobacco with distinctive colour, texture, burning qualities and flavour are required and must be established and that over-production before establishment of type should be avoided at all costs.

The district details of European acreages and yields in 1931 are given in annexure G.

Native-grown tobacco was purchased in the following amounts.

	Ex private estates.	Ex Crown land.	Total
Northern Province ...	994,613 lb.	5,292,877 lb.	6,287,490 lb.
Southern Province ...	431,852 "	1,163,797 "	1,595,649 "
	<u>1,426,465 lb.</u>	<u>6,456,674 lb.</u>	<u>7,883,139 lb.</u>

The totals were purchased in the various districts as noted below.

District.	Weight purchased in lb.		Total.
	Private estates.	Crown land.	
Mlanje ...	—	489,116	489,116
Cholo ...	8,787	45,143	53,930
Blantyre ...	23,426	161,440	184,866
Chiradzulu ...	237,346	380,158	617,504
Zomba ...	167,085	87,285	249,370
Upper Shire ...	208	655	863
Ncheu ...	6,089	111,819	117,908
Dedza ...	—	263,635	263,635
Lilongwe ...	505,308	3,079,792	3,585,100
Fort Manning ...	160,839	36,508	197,347
Dowa ...	322,377	1,423,736	1,746,113
Kota Kota ...	—	377,387	377,387
	<u>1,426,465</u>	<u>6,456,674</u>	<u>7,883,139</u>

The native Crown-land growers of the Northern Province were intensively supervised by the European field staff of eleven and the 215 capitaos of the Native Tobacco Board. The need for extension of supervision to the growers of the Southern Province is realised and a European Supervisor with trained native capitaos was sent into the district towards the end of the year in preparation for the 1931-32 season. The number of registered growers on Crown land in the Northern Province was 32,153, an increase of 1,039 over 1929-30, while the number in the Southern Province was 10,708, a decrease of 323.

In the Northern Province climatic conditions were not favourable for tobacco in January and February, the rainfall being too high, but good growing and ripening weather in March and April gave more gum and body than were expected. The total crop sold in the central buying stations of the Native Tobacco Board was 4,880,915 lb. Under normal weather conditions, the crop would have been at least 6,000,000 lb. The average amount of leaf sold per grower was 165 lb. and the average price obtained was slightly above 3½d. At 3½d. per lb. each grower received £2-8-1½ and the total disbursement to the Crown-land growers of the Northern Province was £71,180.

The shortfall in quantity of crop was accompanied by a distinct improvement in quality which was obtained by intensive tutoring in the field and by the institution of a system of passing stations at each market whereby all leaf was graded and passed by the Native Tobacco Board's officers before being offered for sale. The grades in use were: No. 1, wrapper, over 22 inches; No. 2, short wrapper, 18-22 inches; No. 3, filler, 9-18 inches; No. 4, nondescript. The arrangements worked well and met with the approval of the buyers. At the end of the season there was no difficulty in persuading the growers to destroy in the villages the unsaleable leaf which was left on their hands.

The central buying stations of the Northern Province opened on May 18. Their number was reduced to eight by the closing of the Ngara market. The total number of buying booths was 96 and of buyers (principals) 15.

On the whole the demand for the Northern Province crop was keen. It is clear that the native dark-fired leaf in question has obtained a sound footing in the market. By control of seed supply and maintenance and improvement of quality every effort is being made to consolidate its position. It remains to endeavour to produce each year a crop of a quality and amount that will find a ready sale and so avoid a slump of prices on the one hand and an unhealthy inflation on the other, and to extend the application of this policy to the Southern Province.

The actual amounts sold in the various markets of the Native Tobacco Board were as follows. There is a discrepancy of 428 lb. between the market figures and the total given above, but the figure 4,880,915 lb. is correct.

	lb.
Nathenje	435,692
Maunda	995,422
Lombadzi	825,404
Lingadzi	336,605
Mponela	1,035,288
Malenga	377,387
Kalolo	486,241
Mudi	388,448
	<u>4,880,487</u>

The purchases of native tobacco and the distribution of registered growers by districts are shown in annexure G.

The quality of the Southern Province native crop was higher than was expected but the crop was disappointing on the whole. Handling during growth and curing is capable of great improvement. It is anticipated that in future the demand for Southern Province native tobacco will increase as the efforts of the staff of the Native Tobacco Board begin to bear fruit.

It is hoped that the following table will be of interest. It shows how the Crown-land growers of the Northern Province have increased since 1927-28 while those of the Southern Province have decreased, and it brings out the recent rapid increase in the numbers of tenant or private-estate growers in both areas. Approximate percentages of increases or decreases over the previous year are also included. It should perhaps be explained that in the private-estate or tenant system the native grower is given a piece of land, free seed and free tuition in growing and curing. He usually sells his crop to the European landholder. The latter does not take a percentage of the crop and the tenant may sell elsewhere if he is dissatisfied with his landlord's price and is not under contract to sell to his landlord. The tenant system is popular and it works well on the whole. It is in the interest of the grower to produce the best possible leaf and in the interest of the landlord to do all he can to assist his tenants to maintain and improve quality.

Season	Northern Province Numbers of registered growers				Southern Province Numbers of registered growers			
	On Crown land	Percentage increase or decrease on previous year	On private estates	Percentage increase or decrease on previous year	On Crown land	Percentage increase or decrease on previous year	On private estates	Percentage increase or decrease on previous year
1927/28	20,718	—	545	—	11,208	—	2,290	—
1928/29	27,505	+33	771	+41	13,579	+21	5,723	+150
1929/30	31,114	+13	1,120	+45	11,031	-19	5,154	-10
1930/31	32,153	+3	2,650	+137	10,708	-3	6,392	+24

These figures are significant of a change in the structure of the tobacco industry of Nyasaland. The product of all the growers of the table is the dark-fired variety of tobacco which now occupies such an important place in the economy of the country, and the development of the tenant system has been accompanied by a decrease in the growing of dark-fired leaf by Europeans with the aid of monthly labour.

The Nyasaland Tobacco Association was reconstituted during the year under review. It is now supported by an income derived from a small cess on exported tobacco and it is affiliated to the Tobacco Federation of the British Empire. All European tobacco growers can become members of the association on payment of a registration fee of five shillings. The well-being of the tobacco industry is the general care of the association and a sub-committee was appointed to consider the question of the classification of types of tobacco in Nyasaland. This matter is discussed under *Crop observations* in annexure C.

The writer welcomed the formation of the Nyasaland Native Tobacco Exporters' Association and appreciated the courtesy of an invitation to attend the meetings of the association. The members were very helpful in many matters affecting the buying of native tobacco and other aspects of the industry.

Cotton.—In 1931, European-grown cotton amounted to 225 acres which gave a yield of 159 cwt. of lint. European production has declined steadily over the the past few years and it is now almost a negligible quantity.

Native-grown cotton, on the other hand, was an expanding peasant industry until 1931 when low prices and unfavourable weather depressed both the planting and the yield. It should not be necessary to draw attention to the fall in cotton prices which has taken place, but it may be mentioned that in 1929 the native grower obtained 2d. and 1½d. for his first-grade seed cotton, in 1930 1d. and ¾d., and in 1931 ¾d. and ½d. The larger 1931 price was paid in Lower Shire and the smaller in Chikwawa and the other more northerly areas, namely, Central Shire, Blantyre, Mlanje, South Nyasa, Ncheu, Dedza and Dowa. Whereas the Lower Shire and Chikwawa prices were provided entirely by the British Cotton Growing Association, the ½d. per lb. for first-grade seed cotton in the other areas was provided equally by the association and the government. In

other words, the association was unable to offer more than $\frac{1}{4}$ d. per lb. and government subsidised the association's buying to the extent of another $\frac{1}{4}$ d. per lb. in order to avoid a breach of faith with the growers and to keep the industry alive in the northern cotton area. The subsidy was estimated to cost government the sum of £2,000 but a much smaller sum was actually required. The reason for this will be brought out later. It should be mentioned here that there has been a misunderstanding with regard to the area which was subsidised with $\frac{1}{4}$ d. per lb. The area was as stated above and it did not include North Nyasa. Cotton growing was not encouraged in North Nyasa in 1931 and there were therefore no native growers.

The position of the British Cotton Growing Association in relation to the 1931 cotton crop requires a word of explanation. The five-year agreement with the association expired in August 1931 and the association refused to renew it on the grounds that the association had nursed the industry through its infancy and that the time had arrived for throwing open the purchase of the cotton crop to commercial enterprise and competition. In this connexion it should be noted that the association had lost a large sum of money in its purchase of the 1929 and 1930 crops and that the 1931 season was not a favourable time for the buyer of cotton. Prices were such as to cause him to avoid the market rather than show anxiety to enter it, and there is no doubt that, had the association not come forward in 1931 with an offer to buy the crop, the native grower would have been left with it on his hands and government would have had to intervene.

It was only natural that the native growers should be disappointed with the 1931 prices. In addition, the numbers of markets were cut down. In Lower Shire and Chikwawa the eleven markets of 1930 were reduced to four in 1931, namely, Port Herald, Chiromo, Maperera and Mitoli, and the nineteen markets in the northern cotton-growing area were cut down to eight, namely, Palombe, Kambalame and Chigaru (Lisungwe), Balakas, Fort Johnston, Kasanga, Ntakataka and Domira Bay. These changes made it necessary for the grower to carry his cotton longer distances than he had been accustomed to, and it should be added that the prices quoted were paid for first-grade cotton only and, in fact, that only first-grade cotton was bought. Every effort was made by the officers of the administration to explain the marketing position to the growers. After purchase, cotton was carried free of cost by the Marine Superintendent and by the Chief Transport Officer, and the railway authorities reduced their rates on seed cotton in transit to the Chiromo and Port Herald ginneries and on lint from Blantyre and Limbe to Chiromo and to Beira from the ginneries. The position therefore was that the British Cotton Growing Association (despite the fact that it had no agreement with government), the local authorities and the railway management did what was possible to support the native cotton industry and incurred financial loss in doing so.

It was known that falling prices had led to a decrease in the number of native growers from 1929 onwards and a further decrease was anticipated in 1931. A large amount of seed, however, was distributed for the 1931 crop, the actual amount being over 760 tons, and it was calculated from this amount that with a normal season over 4,500 tons of seed cotton could be expected from the southern area, that is, Lower Shire and Chikwawa, and at least 450 tons from the northern cotton-growing area. The respective amounts which were actually bought from the growers were 2,166 $\frac{1}{2}$ tons and 310 tons. These amounts fell far short of the estimated amounts; in fact, the shortage was so great that it could not be entirely accounted for by unfavourable climatic conditions which did not permit of a second crop, by the buying of first-grade cotton only and by the possibility that the seed taken by the growers was not sown in its entirety. It had to be concluded, therefore, that the growers had been deterred by low prices and increased distances to markets from bringing forward all the cotton they had produced and this opinion was supported by those who were in close touch with the growers and in a position to form a sound judgment. It follows then that prospects were not as bright as might have been wished towards the end of 1931 when it was necessary to consider the question of the distribution of seed for the 1932 crop. This remark refers to home market prices as well as to the attitude that the native grower might be expected to show towards the 1932 cotton season. Cotton prices firmed slightly towards the end of 1931 but not sufficiently to place the local industry on a sound footing. The outlook for 1932 was so uncertain that it was considered very unlikely that there would be any inducement to commercial enterprise to enter the local market. The British Cotton Growing Association suggested, however, that the natives should continue to plant and intimated that while it was unable to guarantee prices it would undertake to provide markets similar to those of the 1931 season. It also considered that the 1931 prices should at least be maintained. It should be noted that the association's 1931 price for all areas outside Lower Shire and Chikwawa was $\frac{1}{4}$ d. per lb. and not the $\frac{3}{4}$ d. that had been paid with the aid of the government subsidy and that it had already been decided that no subsidy could be paid in 1932. The outlook for the growers of the northern area in particular was thus far from bright, and after careful consideration government decided that it would not recommend the natives of the northern or $\frac{1}{4}$ d. per lb. area to grow in 1932. With regard to the southern area with its larger prices of $\frac{3}{4}$ d. (Lower Shire) and $\frac{1}{2}$ d. (Chikwawa), the growers were advised by the administration that, while the 1932 prices were expected to be not less than those of 1931, government could give no guarantee that the 1931 prices would be maintained. It is therefore anticipated that the growers of Lower Shire and Chikwawa will show a further decline in numbers in the coming season. The position at the end of 1931 may therefore be summarised as follows: cotton growing will be continued in Lower Shire and Chikwawa and will be discouraged in 1932 in the remaining areas. An exception has been made, however, in the case of the growers of the Lisungwe district (Central Shire and Blantyre) and seed will be distributed. The growers have demanded it and the Lisungwe area is used as a special reservoir for the production of seed of the improved variety known as U4. It has been made plain to the Lisungwe growers that only $\frac{1}{4}$ d. per lb. may be paid for their seed cotton in 1932 and that even that small price is not guaranteed.

Towards the end of the year the British Cotton Growing Association gave its usual help in seed distribution for the 1932 season. The association and the District Agricultural Officer had called attention to waste of seed in the past and it was arranged that efforts to check the waste should be made when distribution was begun in early 1932. It was also decided that, if sufficient seed was available, only U4 should be given out to growers and that, owing to the continued severe depression in the cotton industry, growing should be confined to the Port Herald, Chiromo and Chikwawa areas with the addition of the small Lisungwe area.

Purchases of native seed cotton over the last three years are shown below. As mentioned above, prices fell in 1930 and it might have been expected that growers would be fewer in that year. This was actually the case, but the season proved to be an almost ideal one and production therefore increased.

	1929		1930		1931
Seed cotton purchased	3,505 tons	...	5,448 tons	...	2,477 tons

Cotton production by districts is shown in the following table for 1930 and 1931.

		1930		1931
Lower Shire	...	2,315 tons	...	1,126 tons
Chikwawa	...	2,418 "	...	1,040 "
Central Shire	...	266 "	...	199 "
Mlanje	...	28 "	...	3 "
Blantyre	...	44 "	...	22 "
Upper Shire	...	24 "	...	— "
South Nyasa	...	26 "	...	3 "
Nchen	...	58 "	...	17 "
Dedza	...	122 "	...	26 "
Dowa	...	86 "	...	41 "
North Nyasa	...	61 "	...	— "
Total	...	<u>5,448</u> "	...	<u>2,477</u> "

Export of cotton seed declined from 1,620 tons in 1930 to 628 tons (valued at £1,256 15s. 3d.) in 1931.

Owing to financial conditions, it was not possible to employ the usual European help during the uprooting time, but special assistance was given by the administration and the danger of ratooning was avoided. Attention to uprooting dates is required. On the whole they should be put forward but, owing to economies and the conditions of the 1931 harvesting season, it was not possible to take action. Reference should be made to the report of the District Agricultural Officer, Port Herald, for interesting facts and figures relating to the native cotton industry in his area.

Tea.—The acreage under tea increased by 1,728 during the year under review. The total acreage is now 11,414 of which 8,287 acres are in the Mlanje district and 3,127 acres are in Cholo. The acreage under plucking in 1931 was 6,514. Production amounted to 2,193,296 lb. of made tea as against 1,904,000 lb. in 1930. Local sales accounted for 179,536 lb. while actual export of tea in 1931 amounted to 1,963,452 lb. valued at £49,129.

An extended acreage and an increased production seem to point to prosperous times, but the actual state of affairs was that tea could not be marketed at a profit and that estates were kept open and development proceeded only with the exercise of the strictest economy. Salaries and wages were reduced, labour was cut down, and the services of ten European managers and assistants were dispensed with. Importations of seed from Ceylon and India were restricted and the use of fertilisers was discontinued or reduced to a minimum. Transport costs also received attention and fine plucking was done with resulting smaller bulk. The building of new factories foreshadowed in last year's report was postponed.

In a paper given to the members of the Tea Research Association the attention of the industry was directed to certain aspects of tea growing and factory practice which were open to improvement or worthy of investigation. It was not possible to make a beginning with the work of a new experimental station, the plans for which are prepared, but arrangements were made for estate experiments with ground cover plants. On the other hand, it is a pleasure to record the successful results of the investigation of the disease known as tea yellows. This subject is referred to in annexure E and on page 13. The Mycologist continued to reside in the Mlanje district and to devote most of his time to tea work. The Tea Research Association appointed several of its members to serve on an advisory committee along with members of the Department of Agriculture and the writer wishes to thank the committee for its helpful co-operation during the year.

Coffee.—The acreage under coffee in 1931 was reported to amount to 1,542, an increase of 286 acres, but the total yield declined from 1,286 cwt. to 1,175 cwt. The acreage in bearing is about 600 only so that it may be said that coffee growing in Nyasaland shows signs of revival. The acreage in the hands of individuals and companies is 1,288 and in the hands of missionary societies 254. The number of holdings of the former class is 34 but of these only three amount to or exceed 100 acres. The number of mission holdings is eleven. They are distributed over six missionary societies and the largest of them is 85 acres. Of the total yield about 417 cwt. was disposed of in the country and about 758 cwt. was available for export direct from the estate. Several satisfactory prices were obtained during the year.

Sisal.—Sisal is another example of an expanding industry which has been hard hit by prevailing conditions. The production fell from 1,305 tons in 1930 to 153 tons in 1931. Actual export figures for the two years were 1,284 tons valued at £29,607 and 242 tons valued at £2,661. The number of estates in the Protectorate is four and of these three were closed down during 1931. At the time of writing it has to be regretted that the future of the sisal industry has not become clear.

Rubber.—There is only one rubber (Para) estate in Nyasaland. Its acreage is 1,500. Prices were so unremunerative in 1931 that no tapping was done and no rubber was exported. In the previous year exports of rubber amounted to 94,185 lb.

Other agricultural produce.—Under this heading there are included items of agricultural produce which are of comparatively small amount. Figures of export for 1929, 1930 and 1931 are given in the table of exports on page 5.

Portuguese East Africa took all the maize, maize flour, potatoes and groundnuts of the table and a proportion of the capsicums and chillies. The remainder of the capsicums and chillies went to the United Kingdom, Northern Rhodesia and Tanganyika Territory. The rice was exported to Northern Rhodesia and the beeswax to the United Kingdom and Germany.

Native food crops.—As the Department of Agriculture has only two field officers, full reports on food-crop conditions can be obtained only from the districts in which the officers are stationed, viz., the Lower River (Lower Shire and Chikwawa) and North Nyasa. In the former district the *machevere* (*Pennisetum typhoidem*) crop was good. Some of the earliest gardens were harvested in January and most of the crop was in by the middle of March. The yield was estimated at 1,000-1,200 lb. of seed per acre; it was probably as high as 1,500 lb. in the best gardens. Smut was found in some gardens but the attack was not serious. The *mapira* (*Sorghum vulgare*) crop was poor in parts. The yield varied from 600-700 lb. per acre in the best gardens to little or nothing in the worst. In the latter aphid and stem-borer did much damage. A measure of control of stem-borer may lie in the destruction of stalks after harvest, but the severity of attack may be correlated with ineffective and insufficient rainfall and soil in poor heart generally. Some gardens were attacked by a smut and experimental treatment is therefore being tried. Witchweed and broomrape were present but not to the extent of past years. Some of the early-planted maize in Chikwawa succumbed to drought in December and on the Ndindi marsh the first crop was damaged to a small extent by floods, but on the whole the crop was satisfactory. The estimated yield per acre was 1,000-1,200 lb. of shelled grain for the first crop and 500-600 lb. for the second. On *mpala* land the crop suffered from short rains in February but yielded about 800 lb. per acre. The *mawere* (*Eleusine coracana*) crop was harvested in April-May and in many gardens the yield was 1,000 lb. of grain per acre. The rice crop was good and a larger acreage of sweet potatoes than usual was planted. Beans on *mpala* land cropped badly with the exception of green gram (*Phaseolus mungo*), but *chimbamba* (*Phaseolus vulgaris*) did well under *dimba* (alluvial flood-land) conditions. Pigeon pea (*Cajanus indicus*) has not been a popular crop hitherto on the Lower River but in 1931 it was treated more seriously, especially on *dimba* land to the south of Port Herald, and many natives have said that they will pay more attention to it in the future. Pigeon pea has a high food value and crops well on the Lower River. It has been suggested to growers that it should be interplanted with maize and cotton. Many small patches of groundnuts were grown and the yield varied with rainfall conditions.

In North Nyasa native food crops were good on the whole. Work was devoted to the extension of the cultivation of pulses and the soya bean was introduced and distributed free with a view to adding nitrogenous food material to the usual maize and other flours. Green gram could be widely and advantageously grown and the Tepary bean may prove worthy of extended distribution. Great progress in the development of rice growing was achieved. Preliminary observations on and collections of local strains were made and mass-selections of ten native varieties are under trial and experimentation. By propaganda the native growers were induced to lay down pure instead of mixed seedings and by instruction in correct time of harvesting and preparation of the rice for the market a great improvement in quality was effected. In addition, demonstrations in grading of the crop were given with satisfactory results, and the percentage of No. 1 quality that found its way to the Karonga market was very encouraging. Rice sold for export out of North Nyasa and consumption within North Nyasa amounted to 239,580 lb. and was valued at £669 7s. 6d. If it may be taken that the grower himself consumes half the crop, it follows that the total production of North Nyasa was 479,160 lb.

In other lake-shore districts, the amount of rice sold to government was over 100 tons and the amount sold for export to other parts of the country was estimated at over 30 tons. Local consumption must have accounted for another 100 tons. Improvement of rice production and marketing on the lines adopted in North Nyasa would be highly beneficial to other lake-shore districts but the work cannot be undertaken under present conditions.

On the whole, maize which is the staple foodstuff in most districts bore well during 1931. Small quantities of wheat continued to be grown in such districts as Ncheu and North Nyasa.

Tung oil.—Enquiries were made regarding the progress of the plantings of tung oil in the country. Results have varied but it may be said that on the whole the young trees promise well, and a further point, perhaps of great significance, is that the great majority of the plants behave as tung oil does in its native habitat, that is to say, they cast their leaves and have a resting period during the cold weather. Other recent plant introductions are mentioned in Part II of this report.

PART II. WORK OF THE DEPARTMENT OF AGRICULTURE.

District work.—Details of district work will be found in annexures A and B. The District Agricultural Officer, Port Herald, continued to co-operate in the work of the Empire Cotton Growing Corporation station near Port Herald. In North Nyasa the District Agricultural Officer continued his experimental work on a small area loaned without charge by the African Lakes Corporation and the writer wishes to place on record his appreciation of the courtesy and helpfulness of the action of the Corporation.

In the Lower River much propaganda work was done by the District Agricultural Officer but it cannot be claimed that a noticeable general improvement in methods has taken place. Gardens were as dirty as ever and the garden that was cleared and planted and afterwards abandoned was too common. Mass improvement is therefore a hope for the future but there are indications that the more intelligent native cultivator is willing to move forward in certain directions, particularly with reference to communal grain stores and ploughing of gardens. With the ordinary types of grain stores wastage is heavy and the native can hardly be blamed for wishing to sell as much of his grain as possible at harvest time and for making the rest into beer. Sale takes place to Indian traders and later in the season the native has too often to buy back his grain at a price which greatly exceeds that which he received for it. The yearly periods of food shortage in December, January and early February are thus intensified. The purpose of the communal stores is the conservation of foodstuffs in the villages and the avoidance of the evils mentioned above. In 1931 five grain stores were built on the Port Herald Experimental Station and two in villages. Only one of the latter was filled during the year. The stores were experimental in nature and valuable lessons have already been learned with regard to the best type of store and the methods of ensuring good storage. The communal store in Makoko's village was filled in July with 114 contributions which gave a weight of grain of 3,842 lb. When it was opened and emptied in December the grain was found to be in excellent condition and the owners of it appeared to be pleased with results. Germination of the stored seed was not affected by the treatment undergone by the seed during storage. Village headman Makoko has asked for two more stores in 1932 and the scheme shows promise of extension. The system of communal storage cannot be said to be firmly established, but progress has been satisfactory and it has been demonstrated that communal storage is possible and safe and likely to lead to results of economic and social value. In the case of ploughing of gardens, the demands for the ploughs were so great that work could have been found for three times the number of implements and oxen that were available. No ploughing was done until the gardens were thoroughly cleared and stumped, and the cost was quoted before the work was begun. It is true that owing to the general depression payment could not be and was not insisted upon but some of the natives concerned showed evidence of good faith by trying to pay a part at least of their indebtedness.

The selection of seed of food crops for storage at the Port Herald Experimental Station and the exchange of grain for selected seed produced on the station have been encouraged and propaganda towards the extension of seed selection in native gardens will be continued. The problem of soil erosion and consequent loss of fertility in native gardens in the Lower River area received attention during 1931. A large scheme of storm draining, strict enforcement of the law forbidding cultivation of banks of streams and reafforestation of stream banks are required. A certain amount of ridge terracing of native gardens has been done and a demonstration plot of contour terraces has been laid down. The problem is such, however, that the District Agricultural Officer cannot cope with it on the scale demanded by its importance and it really requires a whole-time officer.

Experimental work on food crops at Port Herald has brought to light interesting problems which will receive further attention. Spacing of *mapira* and maize requires investigation and broadcasting of *macheuere* appears to give a heavier yield than other methods. Methods of harvesting groundnuts and the varietal resistance of *mapira* to disease will well repay investigation.

In North Nyasa yield and time-of-planting trials of local and introduced varieties of groundnuts, maize, green gram and finger-millet were carried out on the experimental grounds, and methods of trapping rats (which are particularly destructive to cotton in both field and store) were tested. Mention has already been made of the successful work done with rice.

From the month of June 1931 North Nyasa was threatened with locust invasion and the natives were therefore advised to increase their acreage under sweet potatoes, cassava and groundnuts, these crops being less liable to attack than the staple graminaceous food crops of the district.

Plant introductions.—Mention has already been made of tung oil, the seed of which was distributed by the Conservator of Forests. A list of other recent introductions will be found in an appendix to annexure C and mention may also be made of the maize from British Honduras which is referred to in annexure A.

Chemistry and soils.—The departmental work conducted under this heading endeavours to extend knowledge of Nyasaland soils and of the best treatment of them for each crop to be grown on them, and it therefore takes into consideration the relationship between soils, crops and meteorological conditions. It will be a good thing when it can be supplemented by plant-breeding work which will develop improved varieties but it is not possible to undertake plant breeding at the moment. Valuable work, however, is being done in tobacco selection.

The Assistant Director and Agricultural Chemist is in charge of the work of the Zomba Experimental Plots and in his report (annexure C) attention may be directed to the soil and crop studies and to the explanation of the principles by which the work is guided. Manurial experiments designed to show effects of varying treatments on yield and ripening of tobacco, tea and small grains were carried through. The results are worthy of study for they have practical bearing and they lead to general conclusions of importance, for example, regarding the value of organic matter and its contained nitrogen. The sections of the report entitled *Extension work* and *Crop observations* should be read with care and attention may also be drawn to the discussion of the difficulties of field experimental work with tobacco.

Entomology.—The Entomologist was absent from the Protectorate from the end of January until the month of September. His report (annexure D) makes special mention of certain tobacco and tea pests and of locusts, and it should be noted that his remarks regarding tobacco pests and disease refer to the planting season towards the end of the year 1931 for 1931-32. Tea termites are an important matter to which the Entomologist will continue to give attention. Concerning locusts, it may be said that Nyasaland was fortunate to escape invasion during 1931 and that the threat of invasion is certain to become greater in 1932.

Mycology.—The Mycologist brought his work on tea yellows to the stage of being able to show that the cause of the disease was sulphur deficiency, and he is now able to recommend simple methods of prevention and cure. In this the tea planters are to be congratulated. Notes on other tea diseases and their investigation and also on diseases of food plants will be found in annexure E.

Botanic Gardens, Zomba.—Good progress has been made with the re-forming of the denuded slopes of the gardens and cover plants are being grown with success. An effort was made to label some of the best-known trees and much clearing up and draining was done.

Publications.—No local publications were issued during 1931 but arrangements were made to start a new series of departmental bulletins which will begin in 1932.

Staff.—The following officers were on leave during the year.

Capt. C. SMEE, M.C., Entomologist, from January 24 to September 22.

Mr. J. A. CALLOW, Senior Clerk, from January 1 to January 15.

Mr. J. A. A. CHANNER, Senior Clerk, from October 14 to December 31.

Capt. A. J. W. HORNBY, M.B.E., Agricultural Chemist, acted as Assistant Director of Agriculture from January 1 until April 28 when he was appointed to the combined post of Assistant Director and Agricultural Chemist.

Mr. H. C. DUCKER, Cotton Specialist, Empire Cotton Growing Corporation, was on leave from May 23 to December 31. During his absence his duties were performed by Mr. W. L. MILLER, Assistant Cotton Specialist.

Financial.—The following table gives an analysis of the cost of the operations of the Department of Agriculture for 1931.

				Approved estimate	Amount actually spent.		
				£	£	s.	d.
PERSONAL EMOLUMENTS							
European staff	...	...	...	6,181	...	5,674	1 8
Native staff	...	...	...	640	...	588	12 0
				6,821	...	6,262	13 8
OTHER CHARGES.							
Travelling	...	...	...	1,037	...	639	5 4
Passages	...	...	...	421	...	439	16 11
Experimental work	...	...	...	150	...	107	11 9
Distribution of cotton seed	...	...	...	200	...	200	0 0
Botanic Gardens	...	...	...	65	...	62	7 6
Contribution to agricultural show	...	...	...	120	...	120	0 0
Plant disease and pest treatment	...	...	...	250	...	40	5 3
Books	...	...	...	50	...	50	7 2
Tools and equipment	...	...	...	250	...	202	15 0
Seeds and plants	...	...	...	150	...	18	13 1
Incidentals	...	...	...	55	...	28	9 1
Uniforms	...	...	...	43	...	36	7 0
Native cotton industry	...	...	...	150	...	145	0 0
Experimental work, E.C.G.C.	...	...	...	600	...	600	0 0
Travelling, E.C.G.C.	...	...	...	344	...	258	18 3
Typewriter	...	...	...	25	...	25	3 9
Bush cars	...	...	...	42	...	38	17 3
				3,952		3,013	17 4
				£10,773		£9,276	11 0

PART III. WORK OF THE EMPIRE COTTON GROWING CORPORATION.

Permission to print in full the report on the work of its officers in Nyasaland (annexure F) has again been given by the Empire Cotton Growing Corporation. As Mr. Ducker, who, as Cotton Specialist, is the senior member of the staff, was absent on leave when the report was drawn up, the three parts of it referring to the Makwapala, Domira Bay and Port Herald Experimental Stations have been written by Messrs. Miller, Hoyle and Lawrence respectively. The period covered by their reports is the year ending October 31 while the report of the Department of Agriculture covers the year ending December 31.

The useful and practical work of the corporation was continued in 1931. The full results of it will not be seen until the prevailing depression has passed away but it is anticipated that they will be of great value when it is possible to replace the present policy of contraction by a policy of expansion. The most promising stock is that known as *U4* and it will be noted that much attention has been devoted to the various aspects of its cultivation. Time of planting is a matter of great importance in Nyasaland. Present evidence and past experience seem to indicate that early planting is on the whole more successful than later planting, but it is desirable to find out if and how far the planting season can be extended. Spacing experiments and strain tests were carried out, and studies of rotations, interplanting, soil conditions and their amelioration were continued. Satisfactory progress was made in the development of the Domira Bay station.

The cost to the Nyasaland Government of its 1931 contribution towards the work of the corporation in the country was £859 of which £600 was spent on the upkeep of experimental stations and £259 on travelling.

PART IV. NATIVE TOBACCO BOARD.

Mr. G. D. N. Bartlett was appointed a Supervisor for work in the Southern Province on November 6 and Mr. J. Foot resigned on September 30.

Leave was taken by Mr. R. J. Sanderson from January 1 to January 15 and by Mr. R. E. Wilbraham from July 4 to December 31.

The members of the board during the year under notice were the Director of Agriculture (Chairman), the Treasurer, the Secretary for Native Affairs and the Honourable Mr. W. Tait-Bowie, O.B.E., Capt. A. J. W. Hornby, M.B.E., was added to the board on February 18. Mr. J. A. Callow resumed his duties as secretary on his return from leave.

An analysis of the cost of the operations of the Native Tobacco Board in 1931 will be found in annexure H.

The chief matters before the board were the extension of supervision of growers in both Northern and Southern Provinces, the rearrangement of certain of the central buying stations, and amendments to the Tobacco Ordinance.

Thanks are due to the members of the staff of the Empire Cotton Growing Corporation and the British Cotton Growing Association for their continued courtesy and helpfulness and to the staffs of the Department of Agriculture and Native Tobacco Board for their work.

W. SMALL
Director of Agriculture.

Report of the District Agricultural Officer, Lower Shire and Chikwawa.

During the year under review the work outlined in the 1930 report has been continued with some slight modifications and additions which are mentioned below in the appropriate places. The services of Mr. G. M. Bobby in the Chiromo area and of Mr. F. Stephens in the Chikwawa area were retained during cotton seed distribution and planting time at the beginning of the season, and the writer wishes to record his thanks and appreciation for the assistance and advice that he has received from them both during the whole year. His thanks are also due to Mr. F. C. Evans and Mr. J. M. Thorburn, who bought cotton for the British Cotton Growing Association at Port Herald and Mitoli, for the information they willingly supplied whenever possible, and to the various District Commissioners for their generous assistance.

METEOROLOGICAL.

The total rainfall for the year recorded at Port Herald was 24.63 inches and the total for the season (November 1930 to October 1931) 27.02 inches. The hottest month of the year was October with an average maximum temperature of 100.0° F. and an average minimum of 72.9° F. The coolest month was June with an average maximum of 80.9° F. and an average minimum of 58.5° F.

Practically the whole of the effective seasonal rainfall fell in the December of 1930 and the January and February of 1931. As will be seen from table No. 1 at the end of this report very little effective rain fell after February. The total March rainfalls for the preceding four years were 8.03, 5.78, 5.76 and 9.50 inches, and it will be seen that this year's March total of 1.85 inches was far below the average. It was certainly followed by a total April rainfall of 3.03 inches, above average, but of this 2.64 inches fell in a day, the remaining .39 inches falling over ten days; practically the whole of this April rain was therefore ineffective. Light rains in May, June and July were followed by complete absence during August, September and the first half of October. As the result of poorly distributed effective rainfall this past season only early planted crops that had established themselves by March survived at all. Of the food crops *machewere* (*Pennisetum typhoideum*) and *mawere* (*Eleusine coracana*) gave heavy yields and early planted groundnuts and maize were good. In many places the *mapira* (*Sorghum vulgare*) crop yielded well, in others very badly, insect and fungus attack (aphid, stem borer and sorghum smut) destroying whole gardens. Cotton planted in January on the *mpala* land gave a good crop; planted in February and March it yielded very poorly.

The rainfall figures given above are taken from the records kept on the Experimental Station at Port Herald and together with the crop notes refer to the Port Herald area only. Messrs. Bobby and Stephens keep daily rainfall records at Chiromo and Chikwawa and the writer is indebted to them for the monthly rainfall totals from their districts throughout the year. It is entirely due to them that he is able to give table No. 2, also to be found at the end of this report. From this table it will be seen that the Chiromo and Chikwawa areas suffered from rain shortage in December but received approximately 2 inches more than Port Herald in February. There is little to choose between seasonal totals for the Chikwawa and Port Herald areas but Chiromo total is considerably less than either. The outstanding differences are to be found in the months of November and December 1930. The figures of the April totals are misleading, Chikwawa alone receiving some useful effective showers during this month.

It will be seen therefore that, although the remarks made with regard to the influence of the rainfall on the crops in the Port Herald area hold fairly well when applied to the Chikwawa and Chiromo areas, some modifications are necessary. In the Chikwawa area maize is a very much more important crop than in the other two where millets, *Sorghum* and *Pennisetum*, are the chief food crops, and for this reason the lack of December rain might have had a very much more serious effect than it did. Maize planted early in November died and little was planted in December. Fortunately good rains fell in January and February and the crop although planted late yielded well. *Mapira* and *machewere* were planted in January and yielded poorly.

In the Chiromo area maize, also planted late, yielded well and cotton planted early in January gave a good crop. The *mapira* crop was a complete failure, *machewere*, after a poor start, gave an excellent yield, and cotton planted after January on the *mpala* land failed to give a crop at all. Late-planted cotton in the *dimbas* gave a fair yield.

It must not be forgotten that the above notes on rainfall and crops are only general for the whole of the three large areas comprising the 2,600 square miles of the Lower River. The marked differences in soil and the very local character of the rainfall make for very wide variations in the growth and yields of the various crops throughout the districts.

COTTON.

The low yield of this year's crop may be ascribed to a combination of poor season and late planting. On the light *mpala* land, especially in the Chiromo and Port Herald areas, only the gardens planted early in January gave a crop. Cotton planted after January germinated badly, made slow growth and yielded poorly or not at all. *Dimba* gardens were as usual planted late,

in March and April, and many gave a fair crop. A peculiar feature of the Ndindi Marsh crop was the sudden dying off of the plants. In mid-October the plants were green and healthy and carrying a fair crop of bolls but by the end of the month the leaves were reddening, the bolls shrivelling and dropping and whole gardens that had promised a good second picking gave no late crop at all. In the Chikwawa district the rainfall in March and April was better distributed and more effective and here later planting gave better results than in the other areas on the Lower River. Much of the soil too in this district is heavier and more retentive. In Chikwawa this year's production of No. 1 seed cotton was 60.8 per cent. of last year's; in the Lower Shire 45.5 per cent.

Seed stores were opened early in January, in one or two cases where there was some danger from flooding in late December, and seed was taken eagerly. A rather acute food shortage in the January and February of 1931 certainly accentuated the native cultivator's natural disinclination for the hard work involved in clearing his cotton garden and some natives who took seed did not plant at all. The number of cotton gardens decreased by 4,961 this year, due in part to laziness but in greater part to the fall in price of seed cotton. In spite of this 95,394 lb. more of seed were taken.

Unlike last season flowering finished early and there was no second flush. The first bolls were breaking by the beginning of May and by the end of the month the first heavy picking had been made from the earliest gardens. The average yield from the gardens that gave a crop was fair. Buying commenced throughout the Lower River on September 14. There were four markets, at Port Herald, Chiromo, Makwiras and Mitoli, and only No. 1 grade was bought. The price paid was $\frac{1}{2}$ d. per lb. at Port Herald and Chiromo, $\frac{3}{4}$ d. per lb. at Makwiras and Mitoli.

From this year's lesson it is obvious that a much longer and greater experience of Lower River conditions is necessary before anything authoritative can be said about time of planting. This season has certainly upset the opinions formed during the past four years and the writer is prepared to admit that the older inhabitants of these parts are right when they say that it is dangerous to plant after February, and that the earlier the crop is in once the heavy January rains have commenced the better.

As noted in last year's annual report (1930) a safe sowing time from the point of view of insect control is with the first good rain after February 15. From the experience of the four previous seasons it was considered that this date was safe in all ways but with the experience gained in the 1930-31 season it is realised that no February or March planting date can ever be given with safety to the native cultivator so long as there is a possibility of years like 1931 recurring. Nine out of ten years may yield well on a late planting date but if the tenth gives a late drought and cotton is a failure the advice is unsound and dangerous. In any year the native is able to plant in either January, February, or March, or in two of these months or in all of them, the actual time depending entirely upon the rainfall. It is felt that the safer plan is to encourage the native to plant early in January after the first heavy rains of the year. He can plant again if an early drought occurs. An earlier uprooting date, say November 15 instead of December 15, will probably do more to help insect control than late planting which will always be risky and will sometimes be very dangerous.

There is a further consideration to be taken into account when dealing with the very primitive Lower River cultivator. Dates convey little if any meaning to him and advice to plant after a date he interprets in his own way as meaning that there is no particular hurry to clear his cotton garden. Advice to plant early with the first rains after the seed stores are opened he understands. In the record season of 1929-30 planting was done in March, poor rains in February making this unavoidable, but gardens planted early in January gave as heavy a yield in spite of the dry February.

In the native gardens the average yield per acre of seed cotton (No. 1 grade only) was 180 lb. On the *mpala* land it was 173 lb. to the acre and on the heavier *dimbas* 190 lb. The lowest and highest yields on *mpala* land were 49 and 571 lb. per acre respectively; on *dimba* land 95 and 504 lb. These figures were obtained from sixty measured gardens chosen at random throughout the district by the Native Agricultural Instructors. The details of these gardens were given to Mr. Boby and Mr. Evans, buyers at Chiromo and Port Herald markets, who kindly consented to note down the amounts of seed cotton brought in by the natives in question, each of whom was provided with a stamped slip for identification purposes.

The following figures are of interest in regard to the 1931 cotton crop. They include the whole of the Lower River (Chikwawa and Lower Shire districts). For purposes of comparison, the 1930 figures are also given.

	Cotton seed issued lb.	No. of issues	Average issue lb.	No. of cotton growers	No. of cotton gardens	Total pop.	Seed cotton sold (No. 1) lb.	Cost
1930 ...	1,371,474	37,610	96.4	—	27,495	56,278	9,383,028	£39,095 5s. 8d.
1931 ...	1,466,868	30,900	47.4	21,214	22,581	?	5,547,001	11,369 0s. 4d.
Incr. 95,394		Decr. 6,710	Incr. 11.0	—	Decr. 4,964	—	Decr. 3,835,427	Decr. 27,726 5s. 4d.

Only No. 1 grade was bought this year. The price paid was $\frac{1}{2}$ d. per lb. in the Chikwawa district and $\frac{3}{4}$ d. per lb. in the Lower Shire district as against 1d. per lb. in both districts in 1930. The proportion of No. 1 grade to Nos. 2 and 3 was estimated at approximately 80 per cent. of the total production.

	Average seed issue		Average production seed cotton No. 1 grade only		
	lb. per grower	lb. per garden	lb. per grower	lb. per garden	lb. per 1 lb. seed issue
1930 ...	—	49.9	—	341.2	6.2
1931 ...	69.1	65.1	261.5	246.2	8.7

Cotton pests.—Owing to the earliness of the main crop this year very little damage was done by cotton stainers. Both *Dysdercus intermedius* and *D. nigrofasciatus* were found in native gardens from February onwards but did not appear in numbers until August and September by which time the bulk of the crop was picked. Some damage was caused by boll-rots, presumably stainer-carried, in some late planted cotton gardens lying to the north west of Chiromo. Bollworms, Sudan, American and spiny, were found in various gardens throughout the districts but at no time was the attack really serious. Lack of effective rain and late planting overshadowed any insect attack this season.

Minor insect pests on cotton were three Pentatomid bugs (*Callidea dregei* Germ., *C. dregei* var. *purpurescens* Wlk., and *Sphaerocoris annulus* var. *ocellata*), a Noctuid moth (*Eggsolis vaillantina* Stoll.), an Arctiid moth (unidentified) and *Oxycaenus* spp. Baboons and kudu did a great deal of damage to cotton gardens near the foothills.

Uprooting.—The date fixed for uprooting this year was, as in past years, December 15. For reasons of economy the department was unable to retain the services of Messrs. Boby and Stephens for this work. Fortunately the crop was an early one and by the allotted time most of the gardens were finished. There were seventy five defaulters in the Chikwawa district and ten in the Lower Shire district. The writer wishes to record his thanks to Mr. Boby who very kindly offered his assistance in seeing that all gardens were finally uprooted.

Cotton seed.—It is obvious from the figures already given that the yearly waste of cotton seed throughout the Lower River is tremendous. Many growers with small gardens of under an acre take 60 to 80 lb. of seed as a matter of course. Bad as the 1931 season was the return of 3.7 lb. of No. 1 seed cotton for every lb. of seed taken was absurdly low. Even the figure for 1930 of 6.2 was far too low and it is considered that an increased figure of at least 10 should be obtained in an average year. The actual saving of a few tons of seed is not of primary importance but native methods of planting and cultivation still cry for improvement and it is by cutting down the supply of seed that such improvement may in some part be effected. So long as 70 to 100 * seeds are put into every hole at planting time with no subsequent attempt at thinning, there is very little hope of real improvement in the native cotton garden. Many natives are certainly beginning to thin and with reasonable planting methods a definite improvement may be looked for in the near future.

Next season it is proposed to give each grower 15 lb. of seed only and to substitute U4 seed for *Nyasaland Upland* throughout the Lower River. If this substitution is carried out a drastic restriction of seed issues will be necessary as the total amount of U4 seed available is limited and falls short of the total amount of seed issued in 1931. It is believed that there will be in any case another drop in the number of growers on the Lower River, a drop at least as large as last year's, and with carefully restricted issues there should be enough U4 seed available for everyone who wishes to plant.

Each grower requiring seed will bring in his 1931 hut tax paper, the back of which will be marked. Issues will be also made on exemption papers and larger growers will receive more seed if available. The weak point of the scheme is that defaulters and young natives not yet old enough to pay hut tax will have difficulty in obtaining seed. They will however be given it after hut tax payers have received their allowance. It is extremely probable that the restriction of seed will result in smaller gardens in 1932. The native grower has been so accustomed to wasting his seed that it will take him a little while to learn to plant carefully. Smaller gardens however should not mean smaller yields; indeed it is certain that many natives would obtain more cotton from small well-cultivated gardens than they do from their large neglected ones. Assuming that the season is an average one the writer is convinced that the yield in 1932 will be greater per garden than in 1931.

With regard to seed stores the writer believes that seed should only be issued in the future from the four or five centres that will be used this coming season. Numerous small stores scattered all over the district undoubtedly lead to seed loss in various ways. Transport is certainly of minor importance where markets are used as stores since lorries that would otherwise return empty from the ginneries return with seed but the losses in other ways are heavy. This year damage in stores that were neglected by the Principal Headmen in charge of them accounted for a loss of some 50 tons of seed in the Port Herald area alone, and the tremendous waste of seed issued was undoubtedly due to the ease with which a native could in one day go to three stores and obtain seed from each. The native grower should be expected to come in and fetch his seed from Port Herald, Chiromo, Makwiras, Mitoli or Muperera. In the case of markets the writer believes that perhaps two more in addition to the five mentioned above are necessary but this is a matter for others to decide.

A further method of restricting seed would be by making the native cultivator pay for it and the writer suggested that in the 1932 season U4 seed should be bought, a small charge of 8d. being made for 15 lb. It was eventually decided, however, that as the 1931 crop was so poor and the price so low the scheme should be dropped for at any rate a year or two. It is probable that a better scheme would be a free issue of 15 lb. to each grower, any seed required after this being paid for at the rate of 1d. for every 5 lb.

In order to discourage late planting next season all seed stores will be closed on March 15.

*These figures are not at all exaggerated. The writer has many times counted the number of seeds per hole in a field just after planting and on many occasions has found more than a hundred. It may also be pointed out that at a seed rate of 15 lb. per acre 16 seeds may be planted per hole at a spacing of 3 ft. by 3 ft.

The U4 cotton bulking scheme.—Early in January a careful census was taken of all the growers in the area surrounding the Port Herald Experimental Station. An earlier census had already been made late in 1930 but it was thought safer to make a second one just before planting time. Copies of the list of names were sent to Tengani, Kalumbi, Chimombo and Port Herald seed stores and the capitaos in charge were given strict instructions to give no seed to any natives whose names appeared on the list. U4 seed was issued to the growers from the station, applicants submitting their 1930 hut tax papers, which were marked on the backs and returned. An original issue of 12 lb. per garden was made but more seed was given afterwards where necessary. During March, April, May and June a captao was engaged in inspecting the gardens and in making notes of planting dates, germination and general cultivation. At harvest time the growers were provided with small stamped paper slips each bearing the name and village of the owner. An arrangement was made with Mr. Evans, the buyer at Port Herald, to buy in this cotton on certain days, the natives concerned being given due notice.

During the early part of September, just before buying commenced, natives throughout the Lower River were officially informed that markets would only be open for a short time. When buying commenced on September 14 cotton was brought in very quickly and it is feared that a great deal of U4 was sold at the market in the first three days' rush before news could come through that buying would continue until December as usual. In spite of repeated assurances to the U4 growers that in any case all their crop would be bought, it is certain that many sold immediately without troubling to present their slips. The temptation to do so must have been very great. The first of the U4 cotton was bought on September 24 at Port Herald market. Just over 6 tons was brought in.

4,560 lb. of seed were issued at the beginning of the season to 323 registered growers. The total amount of No. 1 seed cotton bought was 22,739 lb. which gave a ginning percentage of 34.4 (14,844 lb. of seed and 7,820 lb. of lint). From this it will be seen that the average issue of seed per grower was 14.1 lb., that the average production per grower was 70.4 lb. of No. 1 seed cotton, and that for every lb. of seed issued 4.9 lb. of seed cotton were produced. The average size of the gardens was $\frac{3}{4}$ acres. This is not a very reliable figure as it is the result of measurement of seventeen gardens only, taken as they came on either side of a stretch of native footpath. The measurements were made by the writer and are accurate. Of the seventeen gardens nine were 1 acre, two $\frac{3}{4}$, one $\frac{1}{2}$ and five $\frac{1}{4}$ acre. The average yield per acre, taking the average garden at $\frac{3}{4}$ acre, was 93 lb. of No. 1 seed cotton.

Native cotton gardens.—When the census of Lower Shire cotton gardens was taken this year an attempt was made to divide them up into large and small and to find out the number of male and female growers. It was found that out of a total of 13,142 growers 2,383 were females, and out of a total of 13,879 gardens 388 were large, i.e., were run by natives who employed labour. The number of natives employed in cultivating these 388 gardens (preliminary digging, intercultivation and planting only) was 1,109. The actual figures are given below:

LOWER SHIRE DISTRICT.

LOWER SHIRE DISTRICT.												Natives employed in large gardens		
Section	Cotton growers					Cotton gardens					Total			
	Male		Female		Total	Large		Small		Total				
Tengani	...	3,058	...	364	...	3,422	...	13	...	3,486	...	3,499	...	35
Ngabu	...	683	...	220	...	853	...	10	...	850	...	860	...	26
Nachikadza	...	1,654	...	467	...	2,121	...	42	...	2,375	...	2,417	...	61
Ndamera	...	1,119	...	221	...	1,340	...	90	...	1,294	...	1,384	...	357
Chimombo	...	964	...	89	...	1,053	...	4	...	1,085	...	1,089	...	11
Chipwembwe	...	847	...	180	...	1,027	...	4	...	1,104	...	1,108	...	28
Mlolo	...	2,484	...	842	...	3,326	...	225	...	3,297	...	3,522	...	591
		10,759	...	2,883	...	13,142	...	388	...	13,491	...	13,879	...	1,109

CHIKWAWA DISTRICT.

Ngabu (South)	1,006	84	1,090	17	1,113	1,130	58
Ngabu (North)	—	—	494	—	—	530	—
Makwiras	—	—	3,060	—	—	3,366	—
John	—	—	909	—	—	1,009	—
Daniel	—	—	522	—	—	554	—
Katunga	—	—	598	—	—	644	—
Beleu	—	—	629	—	—	635	—
Ndaeni	—	—	770	—	—	784	—
			<u>8,072</u>			<u>8,652</u>	
Lower Shire Total			<u>13,142</u>			<u>13,879</u>	
			<u>21,214</u>			<u>22,531</u>	

In 1930 there were 27,495 cotton gardens.

The following is a comparison between the 1930 and 1931 seasons in the Chikwawa district.

Section.	No. of growers.				No. of gardens.			
	1930.		1931.		1930.		1931.	
Ngabu	1,964	...	1,584	Decr. 380	2,056	...	1,660	Decr. 396
Makwiras	2,946	...	3,060	Incr. 114	3,316	...	3,366	Incr. 50
John	947	...	909	Decr. 38	1,021	...	1,009	Decr. 12
Daniel	513	...	522	Incr. 9	553	...	554	Incr. 1
Katunga	533	...	598	Incr. 65	593	...	644	Incr. 51
Beleu	1,143	...	629	Decr. 514	1,163	...	635	Decr. 528
Ndaeni	841	...	770	Decr. 71	863	...	784	Decr. 79
	8,887		8,072	Decr. 815	9,565		8,652	Decr. 913

From the Chikwawa figures it will be seen that the largest decrease in the number of gardens occurred in the two sections of Ngabu and Beleu and it is probable that next year the decrease will be greater. Distance of carry to the markets is probably a limiting factor to cotton production in both these areas. Munga market, in the case of the former, and Nkadana market, in the case of the latter, helped the native cultivator considerably, but, now that these have been closed and the Ngabu native has to bring his cotton into Chiromo or Makwiras and the Beleu native into Mitoli, it is probable that, with the low prices ruling, only the nearer villages will continue to grow.

It is estimated that the average size of cotton gardens this year was 1.36 acres. Of seventy-seven gardens actually measured the average area was 1.88 acres but some of these were certainly selected by the Native Instructors for their size and yield. Of these gardens twenty-three were less than 1 acre, twenty-eight between 1 and 2 acres, eleven between 2 and 3 acres, eight between 3 and 5 acres and seven over 5 acres. Of these seven large gardens one measured over 30 acres, one 19 acres and three more over 10 acres. From these gardens the estimated yield per acre was 180 lb. of seed cotton (No. 1 grade) and from the production and census figures the average yield per garden was found to be 246 lb. From these figures the areage per garden was calculated.

Another census was made of the larger cotton growers in the Port Herald area in which it was found that there were fifty four large growers, large again signifying employers of labour. Of these fifty-four, sixteen had cotton gardens of 3 to 4 acres, twenty-two of 5 to 10 acres and sixteen of over 10 acres. These growers between them employed 311 natives.

NATIVE FOOD CROPS.

Throughout the Chikwawa and Lower Shire districts early food crops, *machewere* and early maize, yielded well. The harvest was early and by the end of January some *machewere* was already in head and ripening and some of the earliest maize had been harvested. In Chikwawa, owing to the very poor December rains in many parts of the district, the crops were more backward and a great deal of the early planted maize and *mapira* died off and had to be replanted in January. Nevertheless *machewere* was in head in many gardens by the end of January and good rains during this month helped the later plantings of maize and *mapira* to establish themselves. By the end of February the main crop of *machewere* was ripening and nearly ready for harvest. Good rains this month too helped the *mapira* crops and throughout the Lower River there seemed to be every promise of an excellent harvest. Enthusiasm for bird-scareing on the *machewere* crop waned as more grain was gathered in and more beer made in the villages. By the end of March the prospects for the *mapira* did not look so well, the dry month and a bad attack of aphid and stem borer having taken away all the advantage that a good January and February had conferred. The late maize crop in the Chiromo area also suffered, the plants turning yellow with small poorly-developed cobs. Good April rain in the Chikwawa district saved the late maize crop and with the exception of a small area to the south the yield was good. In the Chiromo area another dry month ruined the *mapira* crop and whole gardens were abandoned. Between Chiromo and Port Herald the *mapira* gardens were bad but to the south many gardens partially recovered and the crop was fair.

In May a famine scare was started, a scare that certainly had some foundation but that was premature and was of course encouraged by the natives themselves. The position then, as reported at the time in answer to an inquiry, was as follows. "The *mapira* crop, together with the remainder of the early maize and *machewere* crops, will provide enough grain to last for another five months at least, i.e. until the end of October and in many villages until the end of December. By then, if all late plantings fail, there will be a famine. There is, however, no reason to suppose that late plantings will fail. Many sweet potato gardens are already well established and there should be, with the usual June or July rains, a good second maize crop. There is every prospect therefore of only the usual food shortage during December, January and February, but nothing worse than this. This applies to the Chiromo area only. There is no prospect of famine in the Port Herald and Chikwawa areas." A sketch map was also made of the Lower River showing the two areas where shortage might be expected later in the year.

Large areas of late *dimba* crops, maize, sweet potatoes and *chimbamba* beans (*Phaseolus vulgaris*) were planted and gave heavy yields and although there was a shortage in some villages there was never any sign of a famine. Right through the year beer-making went on as usual. In December this year foodstuffs were actually more plentiful and cheaper than usual. This was in great part due to the selling of grain bought earlier in the year by Indian traders in the expectation of famine. Absence of famine and shortage of money in the district forced them to sell their stocks very cheaply.

There has been no sign this year of a decrease in the amount of beer made on the Lowe River. The excuse has been that hut tax can be raised from the sale of beer—beer in the district presumably taking the place of washing—but it is doubtful whether selling beer to one another really helps the natives to find their hut taxes, especially in a year of grain shortage. It is believed that a rigidly enforced system of prohibiting beer-making except by licence would help the Lower River tremendously. It is feasible and can be enforced as the writer knows from personal experience in Portuguese East Africa where he has met with the scheme in operation.

Machewere (*Pennisetum typhoideum*).—The crop this year was good. Some of the earliest gardens were harvested in January and by the middle of March most of the crop was in. The yield was estimated at 1,000 to 1,200 lb. of seed per acre; in some of the best gardens it was probably as high as 1,500 lb. Bird attack was light fortunately, since little attempt was made at bird-scaring once the first heads had been harvested. A smut fungus (*Tolyposporium penicillariae*) was found in some gardens but the attack was not serious.

Mapira (*Sorghum vulgare*).—In some areas, particularly to the north and south of Chiromo and in the southern part of the Chikwawa district, the crop was very poor. Many gardens were abandoned to the birds although even in the worst some grain could have been saved. Aphid and stem borer (*Chilo* sp.) did great damage in the bad areas already mentioned. It is probable that the severity of the borer attack is directly correlated with ineffective and insufficient rainfall and soil in poor heart generally. One measure of partial control may lie in the thorough destruction of the stalks after harvest and in the early suppression of all ratooned *mapira*. It is probable that some of the *thengo* grasses are also hosts of this borer. In any case maize is a host and on the Lower River maize will be found in some stage or other all the year round. Many of the gardens between Chiromo and Port Herald are badly eroded, storm water from the hills to the west washing away tons of soil yearly.

The yield varied from an average of 600 to 700 lb. per acre in the best gardens to nothing at all in the worst. In many gardens stalks were burnt early in the year, directly after harvest, but the majority of natives still leave them until November when they start clearing their food gardens for the new season.

Witch weed (*Striga* sp.) and broomrape (*Orobanche* sp.) were found but were not generally so bad as in past years. A smut fungus (*Sphacelotheca sorghi*) attacked some gardens very badly and few escaped a slight attack. An experiment is being conducted on the Experimental Station to test the efficacy of remedial treatments with copper sulphate solution and sulphur dust. The better will be recommended to the natives and those who wish to obtain treated seed will be able to do so at the station.

Maize.—The maize crop this year was good. In the Chikwawa district some of the earliest planted succumbed during the dry December of 1930 but early January rains saved the rest and the later plantings yielded well. To the south, particularly on the Ndindi Marsh, the first crop was caught by the floods in February although very little was totally lost, the natives having sufficient warning to enable them to harvest the green cobs. The estimated yield per acre was 1,000 to 1,200 lb. of shelled seed for the first crop and 500 to 600 lb. for the second. On the *mpala* land the crop promised to yield well but suffered from the shortage of rain in February. The yield was estimated at 800 to 900 lb. of shelled seed per acre.

Mawere (*Eleusine coracana*).—This crop is planted out from seed-beds usually established under a large shady tree such as the *ntondo* (*Cordyla africana*). The beds were planted this year in December, the plants being set out in the gardens in February. By the end of March much of the crop was in head and some of the earliest gardens were ready by April. The main crop was harvested in May. In many places the yield was good and the weight of grain per acre in some gardens averaged just over 1,000 lb.

There was a larger area planted this year than last, the reason given by the natives being that the grain keeps well when stored and is therefore an insurance against famine. Unfortunately its chief use in the village is in the manufacture of beer (it seems to take the place of barley) and it is improbable that there was much *mawere* by the time the annual famine period began.

Rice.—The rice crop was good. Planting commenced in late November and early December and by March the plants were in head. Harvesting commenced early in April. Seed stocks are very mixed and practically the whole of the crop every year is sold to Indian traders.

Sweet potatoes.—The crop yielded heavily in the *dimbas*. A very much larger acreage than usual was planted and both early and late plantings did well. A Curculionid weevil (*Cyrtolus compressus* Hartin) and a millipede did considerable damage to the crop in the field and in the store.

Pulses.—Beans on the *mpala* land cropped badly with the exception of *mpodza* (green gram, *Phaseolus mungo*). The short term pulses (*Vigna*, *Phaseolus* and *Dolichos* spp.) are usually planted in March and with the scanty rainfall that month germination was poor. The best yields of *mpodza* were from gardens planted in late January or February. *Chimbamba* (*Phaseolus vulgaris*) yielded well in the *dimbas*.

Nandolo (pigeon pea, *Cajanus indicus*) has not been hitherto a very popular crop with the Lower River native. It has in the past been planted along the edges of gardens as a boundary mark only and was seldom met with as a field crop. This year, particularly to the south of Port

Herald on the *dimba* land *nandolo* has been treated more seriously and many natives have given the writer to understand that they intend to pay more attention to it next year. Interplanting with maize and cotton has been suggested to them. Pigeon pea has a high feeding value and crops well on the Lower River.

Groundnuts.—Many natives grow small patches of groundnuts for their own use every year. Any surplus is sold to Indian traders but the demand is limited and the price small. The crop is unsuited to the heavier land and on the lighter land the yield is always uncertain, depending entirely on suitable rain during and just after the flowering stage when the fruiting branches are entering the soil. Lack of rain at this period has a serious effect upon the yield and this year the writer saw many gardens in which the fruiting branches were unable to penetrate the hard baked soil surface and died off. To be grown successfully a good soil mulch should be kept round the plants and few native cultivators are prepared to undertake this. The yield this year varied tremendously, depending entirely upon the incidence of rain in the localities in which the gardens were situated.

NATIVE AGRICULTURE IN GENERAL.

During the year most of the Lower River has been visited with the exception of the Chikwawa district. A long circular tour was to have been made late in the year but for reasons of economy this had to be abandoned. No set lectures were given this year owing to lack of time but short talks were given during visits and the Native Instructors were made responsible for the delivery of special advice at certain seasons.

It would not be true to say that any definite improvement is noticeable in the districts. Gardens are as dirty as ever and the garden that has been cleared and planted and then abandoned is still far too common. But while mass improvement is still a hope of the future there have been one or two hopeful signs this year that the more intelligent cultivator is willing to avail himself of every opportunity to move forward. Two of the most encouraging signs have been in connection with the native grain stores and with ploughing in native gardens. Details are given below but it may be mentioned here in passing that the former seems to have caught the popular fancy and shows promise of developing rapidly in 1932 and that in the latter case so many natives were anxious to have the ploughs that there was work enough for three times the number of ploughs and bullocks available. In neither case can it be said that the native was merely keen on getting something for nothing. The two grain stores were built by volunteer labour from local material, the only expense to the department being the cost of nails, wire netting, rat stops and carbon bisulphide for fumigation. No gardens were ploughed until the owners had thoroughly cleaned and stumped their gardens of all bush and tree growth, and the cost was quoted before ploughing started. It is true that owing to the general depression in native agriculture due to the cotton slump the money has been foregone this year but not before some of the natives had already shown evidence of good faith by trying to pay at least part of the money owing.

A few natives have brought in selected seed for storage at the station this year and a few more have come in to exchange grain for selected seed. There was certainly a definite attempt at seed selection last year and the habit will be encouraged this coming year as strongly as possible.

One or two natives, one an influential village headman, have already come to the station to learn how to cultivate and plant their gardens. The writer has visited their gardens to make sure that they understood their instruction and intends to use these gardens as object lessons to nearby villages.

Soil erosion.—The loss of fertility due to soil erosion increases yearly. Storm water from the hills to the west and storm water running off the cultivated lands take literally tons of soil away to the Shire River every year. Large areas of the Lower River are now under permanent cultivation owing to the density of the population, particularly in the south, and the day of the small scattered garden surrounded by bush is past. At present the native makes no attempt at soil conservation, but unless he does so in the near future he will suffer seriously from a rapid decrease in soil fertility.

Gardens lying to the north of Port Herald for a stretch of some fifteen miles are already suffering badly from the effects of soil erosion. Storm water from the western hills has in the past few years removed the greater part of the soil and already the state of the crops, particularly that of *mapira*, reflects the poverty and infertility of the area.

The fine alluvium of which the Lower Shire valley is composed is highly permeable and should with suitable level ridge terracing be able to retain the whole of the rainfall. Such terraces would therefore deal with the problem of the storm water running off the cultivated lands.

The danger from the storm water off the hills is accentuated by the fact that of late years heavy clearing has been allowed up to and along the banks of streams. The only hope of checking this danger lies in a strict enforcement of the law forbidding stream bank cultivation and in a carefully thought out scheme of storm draining. Not only is it necessary to stop further stream bank cultivation but it is essential that reafforestation be carried out along most of the stream banks that have been cultivated in the past.

Drainage maps will be made of chosen areas during this coming year with a view to storm draining, and some observations are being made of the degrees of permeability of different soils. Some natives have been approached with a view to ridge-terracing their gardens and have agreed to carry out the work this coming season under the supervision of the writer. Four fields on the Experimental Station were ridge-terraced this year, the work being completed before the arrival of the November rains.

A demonstration plot of four contour terraces (planted later with pineapples for a spacing trial [see below]) has been made near the Government Rest House on Malawe Plateau close by the main path so that all passing natives can see it. Demonstration ridges have also been made in two native gardens, one at Nkuchi's Village and another at Nchacha's. Another terraced garden was made for demonstration purposes on part of the Chididi Mission garden.

Pineapple plots.—Last year cotton was tried on the Malawe Plateau but failed to give a crop. From general observation it appeared that to be successful cotton should be planted here in November or December. Pineapples do well, however, and there is always a local market for them in Port Herald. Some observation spacing plots have therefore been started this year and the terraced garden at the Government Rest House, referred to above, was planted up with pineapples in April, young suckers being used. Four different spacings were employed, one to each of the four terraces:—

- | | | |
|----------------|---|-------------------------------|
| 1. Triple rows | { | 1 ft. 6 ins. between rows |
| | | 5 ft. between each triple row |
| | | 2 ft. between plants in rows |
| 2. Double rows | { | 1 ft. 6 ins. between rows |
| | | 5 ft. between each double row |
| | | 2 ft. between plants in rows |
| 3. Single rows | { | 4 ft. between rows |
| | | 2 ft. 6 ins. between plants |
| 4. Single rows | { | 3 ft. between rows |
| | | 2 ft. between plants in rows |

- | | | | |
|----|---------------|-------|-----------------|
| 1. | Approximately | 7,920 | plants per acre |
| 2. | do. | 6,600 | do. |
| 3. | do. | 4,224 | do. |
| 4. | do. | 7,260 | do. |

The plots were visited regularly during the year and the plants are well established.

Ploughing in native gardens.—Early in January a $4\frac{1}{2}$ -acre native garden on the edge of Ndindi Marsh was ploughed by the bullocks from the Experimental Station, the native owner building a small kraal for them close by. The cattle and the ploughmen did good work and between two and three hundred natives came from surrounding villages on the Marsh to watch operations. Many were interested enough to make inquiries of the writer as to the cost and possibility of their gardens being ploughed also.

Later in the year six more gardens were ploughed, a total area of some 18 acres. All gardens were measured by the writer before ploughing and the total cost quoted to the owner at the rate of 2s. 6d. per acre for the first ploughing and 2s. per acre for cross ploughing. As already noted, natives were released from their agreements owing to the shortage of money in the district due to the cotton slump. Fifty-four acres more of gardens would have been ploughed had the cattle not been required for station work and already inquiries have been made about next season's ploughing. Two more cattle kraals have been built by natives, one on the Marsh and one at Makoko Village, both for the accommodation of the bullocks when out ploughing.

It is hoped that ultimately some of the native cultivators may purchase their own ploughs and bullocks. It is certain that many will, as soon as they have sufficient money to do so.

NATIVE AGRICULTURAL INSTRUCTORS.

The farm diaries have been kept through the year and although the system is not yet perfect much valuable information has been acquired and the writer has been able to keep in touch with the various districts at times when he has been unable to visit them personally.

It has not yet been possible to provide the Instructors with small demonstration plots and this year the greater part of their work has consisted of propaganda in their districts. Each Instructor has been given a district of his own and he is expected to make a complete tour of that district once every month at least and to record in his diary the crops he sees, their condition and the work that is being done on them.

For various reasons the writer has been unable to give much supervision to the Instructors in the Chikwawa district. A schedule of work was therefore drawn up for them, outlining the propaganda they should carry out during the various seasons of the year. With regard to this Mr. Stephens made some useful suggestions and additions which were incorporated. Copies were sent to him and to the District Commissioner who kindly promised to see that the Instructors were satisfactorily carrying out their duties, during such times as Mr. Stephens was not engaged by the department.

Instructors have done some extremely good work this year but they are necessarily hampered by their lack of training. Trained natives, well grounded in the elementary principles of agriculture, would make a great difference to the district and it is hoped that one day such natives trained by the department will be available for district work.

This year they have carried out the usual census of cotton gardens and they were also responsible for the enforcement of the Cotton Uprooting Rules. They have continued their work of demonstration and some of them are acquiring prestige in their districts. Through them the native cultivator is brought into touch with experimental work being done and they form very useful sources of information. Before much can be taught to the native much must be learnt and the writer realises full well the urgent need for finding the reasons that underlie the present native system of agriculture before attempting to suggest a better one. It is in the unravelling of some of these mysteries that the Native Instructors are so useful.

The six Instructors in the Chiromo and Port Herald areas were with the writer when the communal grain stores at Mlolo and Makoko were constructed and are all now capable of taking charge during the building of others. The three in the Port Herald area also saw the store at Makoko Village filled, fumigated and emptied and now understand the full working of the scheme.

COMMUNAL VILLAGE GRAIN STORES.

As mentioned in last year's report a suggestion was made for the storage and conservation of native foodstuffs in the villages involving the construction of communal village grain stores. Before reporting on the steps taken and the progress made it may be as well to describe briefly the various types of grain stores in present use in the district. They are four in number:

1. The *chikwa* is a conical shaped basket made of woven grass and palm leaf standing about 4 ft. high and with a diameter at its widest part of 3 to 4 ft. Once filled with grain the *chikwa* is kept in the hut.

2. The *tata* is simply a *chikwa* on a platform. A slow smoky fire is kept underneath, the smoke travelling up through the stored grain.

3. The *chete* is an ordinary pole and grass hut built up on a platform. No fire is kept underneath. This store is used for unthreshed grain, *mapira* and *machewere* in head and maize in cob; later in the year sweet potatoes are often stored in the *chete*. The size varies considerably; the height of the walls is usually about 4 ft., the floor area varying between 36 and 64 sq. ft.

4. The *nkhokwe* takes the form of a cylinder made of interwoven split bamboos. In some *nkhokwe* the bamboo walls are plastered with mud but this is not usually done. This kind of store generally stands on the ground but is occasionally met with on a platform and the writer has seen two or three *nkhokwe* side by side on one platform. The size varies but the height is usually about 6 ft. and the diameter about 3 ft.

It will be readily understood that with such primitive methods of storing grain the loss every year is heavy and the native cannot be altogether blamed for wishing to sell as much grain as possible at harvest time and for making the rest into beer. With an efficient, cheap and easy method of storing grain it is believed that the native would tend to conserve his foodstuffs and that the yearly periods of hunger during December, January and early February would disappear.

The grain stores built this year, five on the Experimental Station and two in villages, have been copied from a type suggested by the Tanganyika Department of Agriculture. This consists of a round hut made of interwoven split bamboo plastered inside and out with mud, with a thick mud bottom and covered with a thatched roof with wide eaves. The whole structure is mounted on a platform at least 4 ft. from the ground, the poles of which are provided with wire netting rat stops. Various modifications have been introduced and more are necessary before the stores will give complete satisfaction. One of the weakest points is in the roof which has to be lifted every time the store is filled, fumigated, or emptied. This frequent movement weakens the roof beams in time and it is proposed now to make a small door in the side near the top so that the roof may remain undisturbed. The other weak point is in the top. A layer of loose sand 2 in. thick placed on matting supported by cross bamboos was tried but the join between the sand and the walls was not sufficiently airtight and the top was eventually mudded in leaving a small manhole. This manhole was successfully sealed with sand on matting, the sealing overlapping the hole by a foot at least all round. The old trouble with the roof remained however. The small door in the side should obviate both these difficulties. This wooden door will be hinged with rough leather hinges and when the store has been filled and fumigated the edges will be sealed with mud so that a perfectly airtight join is effected. The timbers all have to be of white ant-proof wood and to make the walls really safe two frames of interwoven bamboo are used, mud being rammed between the two as well as being plastered inside and out. The mud platform floor is also a good 6 in. thick. Inside measurements of the store are roughly 9 ft. in diameter and 3 ft. 6 in. in height with an approximate capacity of 3½ to 4 tons of grain.

The first village grain store was built in April at Makoko Village. All materials were carried in and all work was done by voluntary unpaid labour. After completion the store was left to dry out thoroughly. A final plastering was given with a mixture of wood ash and cow dung. This mixture dries with a hard smooth finish leaving no cracks.

Towards the end of July the store was filled. Some anxiety was felt over the possibility of the development of mould in the grain during storage. Some of the grain, it was thought, might be unripe or damp when brought in and to obviate the danger the grain was passed slowly along a trough made of a bent sheet of corrugated iron, a fire being kept underneath. Care was taken not

to overheat the grain and directly it was thoroughly warm it was weighed and emptied into the store. Filling continued for two whole days and was completed on the morning of the third day. The grain was immediately fumigated with carbon bisulphide. The cubic content of the store was 124 cu. ft. and the dosage employed was at the rate of 8 lb. to every 1,000 cu. ft. of enclosed air space. A shallow tin standing on top of the grain held the fumigant and when it had been placed in position the top was closed with a 2½ in. layer of fine sand on matting. The grass roof was placed over all.

There were 114 contributions of grain to the store and the total weight of grain stored was 3,842 lb. Of this total there were 3,488 lb. of *mapira* stored loose, 141 lb. of mixed *machewere* and *mapira* in one sack and 213 lb. of *machewere* in two sacks. It will be noted that the average contribution was about 30 lb. Such small contributions are not likely to be of great use in the hungry season but this is the trial year for the stores and it is certain that next year contributors will be more numerous and individual contributions larger. Many contributors stated that they intended to use their grain for planting next season. Each one received a dated slip with his name, village and weight of grain. Each entry was made in triplicate and one copy of names and weights was held by the village headman Makoko.

The store was visited regularly once a month, the grain being fumigated at each visit. Early in November it was found that the top of loose sand was not sufficiently air-tight to exclude all insects. The whole top was immediately mudded in with the exception of a small trap door and the grain refumigated. Another inspection a week later showed that the store was now quite airtight.

Emptying took place on December 14 and 16. The seed was in excellent condition and the natives appeared to be pleased with the result. Germination was good, apparently quite unimpaired by the fumigation the seed had undergone. Village Headman Makoko has asked for two more stores for next year.

Of the stores on the Experimental Station one was filled with *mapira* in September, fumigated, closed and left for a month, when it was opened and the grain examined. It was found to be free of weevil and moth, was refumigated and closed again. It was finally opened and the grain taken out for use late in December. Weevil and moth were present but in small number. The grain was scarcely damaged and had lost practically no weight at all. A second store was filled with maize (shelled) early in October, fumigated and sealed. The top was not quite finished when it was filled and the maize was slightly weevil-damaged before it could be treated with carbon bisulphide. It was examined again in November when the grain was found to be free from insect attack.

A third store was filled in October with maize in the cob, the sheathing leaves still intact. This store was built in the same way as the others with the exception of the floor which, made of intercrossed split bamboos, was not mudded. A slow smoky fire was kept underneath. This maize was examined in December and was entirely free from insect attack. It should be noted, however, that the variety placed in this store is suspected of being immune to weevil attack; until the ordinary native maize has been successfully stored in this way nothing conclusive can be stated.

The two other stores built will be used next year. The store at Mlolo Village was completed and will be filled next year.

From the foregoing it will be seen that much remains to be done before it can be said that the system is safely established. It has been demonstrated that seed can be safely stored and that the natives can be induced to bring in their seed and store it communally. It must be pointed out, however, that Village Headman Makoko is an intelligent trustworthy man, very different from the average ignorant lazy headman of the Lower River. This year two or three headmen actually began to collect material for stores in their villages but had to abandon the idea, frankly confessing to the writer that their own people did not trust them.

THE EMPIRE COTTON GROWING CORPORATION EXPERIMENTAL STATION.

The report for this station will be found under annexure F but as this was written in October some later and definite results may be given here.

The total yield of seed cotton from the 25 acres was 2,924 lb. of No. 1 grade and 647 lb. of No. 2 giving an average yield per acre of 117 lb. of No. 1 and 26 lb. of No. 2. Five acres of the total area of cotton were interplanted with *machewere*. The average yield per acre was 89 lb. of No. 1 and 8 lb. of No. 2; the average yield per acre of *machewere* was 964 lb. of seed. It is of interest to note that in two fields of 2½ acres each a very heavy crop of grass was ploughed in in early January as green manure. The average yield per acre from these five acres was 106 lb. of No. 1 and 78 lb. of No. 2, i.e. 42.4 per cent. of the total yield was No. 2. Insect attack was not noticeably more severe than on the rest of the cotton acreage.

With regard to food crops the various observation plots have brought to light some interesting problems into some of which it is hoped to inquire further this next year. Spacing of *mapira* and maize appears to require some investigation and in the case of *machewere* broadcasting appears to result in a considerably heavier yield than any other method of planting. Methods of harvesting groundnuts and varietal resistance to disease in *mapiras* are two more problems that would repay investigation. The ordinary native method of planting with the hoe leaves much to be desired and next year planting will be tried with the ordinary wooden dibble.

An interesting result was obtained from two $\frac{1}{2}$ -acre plots of millets. One of these (1) was planted in the native fashion at a spacing of 3 ft. by 3 ft., the seed, *machewere* and *mapira*, being mixed before sowing. The other plot (2) was planted in alternate lines 2 ft. apart of *machewere* and *mapira*. In the first plot no thinning was done, again after the native fashion; in the second the *machewere* plants were thinned to 6 in. between each plant, the *mapira* to 1 ft. In both plots gaps were filled by transplanting. Planting was all done on the same day in the middle of December and by the end of January in the plot with mixed seed (1) the *machewere* was beginning to head out, and it was ready for harvest by the middle of March. Plot (2) was not ready until a good fortnight later. There was little to choose between the *mapira* in the two plots except that that in plot (2) appeared to be a day or two earlier. The yield of *machewere* from plot (1) was well over double that from plot (2). The yields of *mapira* were practically identical. The differences of course may be purely fortuitous but suggest that the native has found from experience that crowding his *machewere* leads to an earlier and better yield. It has already been noted that broadcast *machewere* gave a better yield than that planted in lines. It seems probable that *machewere* drilled in, at approximately the same spacing as wheat, would give good results.

Stock.—During the year a small flock of goats and a herd of twenty head of cattle (the remains of the old herd belonging to the Department of Agriculture) were acquired for the station. A covered yard was built for the cattle, and pens with open yards were made for the goats and sheep. The sweet potato crop on the station failed and sheep folding experiments were not carried out. More hurdles were made and it is hoped that some folding and grazing trials will be made next year. An attempt will also be made to provide pit silage for the stock through the dry season and $\frac{1}{2}$ -acre plots of close-spaced *mapira* and maize will be grown for this purpose. Daily milk records have been kept for the cattle but no special feeding has been attempted to date owing to lack of satisfactory accommodation. Later it is hoped to keep daily milk records of the goats. Five sheep were fattened and sold in Port Herald this year.

Trees.—Many of the tung oil seedlings (*Aleurites Fordii*) succumbed during the end of the dry season, some to white ants and others apparently to drought. At the end of the year were seven survivors.

Some more oil palms (*Elaeis guineensis*) planted in February 1930 germinated during the year but most of them died off later. There are now only three survivors and these have made practically no growth. They will be planted out on the *dimba* station as soon as it is opened. Some more *Cassia siamea* were planted out in pots early in the year. *Casuarina quadrivalis* and *C. glauca* were planted but failed to germinate. During the end of the year the Forestry Department opened a small nursery on the building block of the station.

EXPLANATORY.

Some of the words used in this report may perhaps appear confusing and unintelligible to those unacquainted with the district and local language. An explanation of them is given,

Lower River as used in this report may be understood to include the two administrative districts of Chikwawa and Lower Shire.

Chikwawa area includes the whole of the Chikwawa administrative district with the exception of a small area on the west of the Shire River which is included in the Chiromo area. It consists of the southern portion of Ngabu's section and lies to the south of the road which runs from Nkabvu village to Saopa village (passing through the villages of Arumenda, Mpamba and Ngabu) and to the south-west of the Nkombedzi wa Fodia River.

Chiromo area includes the whole of the Lower Shire administrative district lying to the north of the Namyala Stream (which rises in the hills and flows due east to the Shire 17 miles south of Chiromo township) and the small area of Chikwawa district mentioned above.

Port Herald area includes the whole of the Lower Shire district lying to the south of Namyala Stream.

Dimba is a Mang'anja word meaning "alluvial soil at the site of streams" (Scott).

Mpala is a Chisena word in very common use in the district. It is applied by the native to land that is not *dimba*, i.e., the land of plain between hills and the river that is never flooded.

There is obviously no very distinct line to be drawn between *dimba* and *mpala* land but the writer finds the terms useful in distinguishing between the two main types of alluvium in the Lower River valley. The *dimba* land is distinctly heavier in type with a large proportion of clay in its composition. It is dark in colour as a rule, more difficult to work and more retentive. Maize, cotton, sweet potatoes and beans are the main *dimba* crops. It may be noted here that many *dimbas* are not flooded yearly but are all more or less affected by a rise in the river through the quick response of their water tables.

The *mpala* land has a very much larger proportion of sand in its composition, in some cases being almost pure sand, is light in colour, easy to work and dries out quickly once the rainy season is over. The chief *mpala* crops are millets, cotton, short-term pulses, groundnuts, sesamum and cassava. Cotton to yield well must be established by the time the rains cease; otherwise the quick drying out and loss of surface moisture stunt or kill the plants before their roots can reach the subsoil water supply.

E. LAWRENCE
District Agricultural Officer.

Table No. 1

PORT HERALD EXPERIMENTAL STATION, METEOROLOGICAL RECORDS, 1930-31.														
	Av. monthly temperature		Range of temperature		Rain-		No. of					Remarks.		
	Max.	Min.	Highest max.	Lowest min.	fall in.		days rain.							
1930														
November	...	100.6	...	75.4	...	109.5	...	70.5	...	0.82	...	1	...	Rainfall effective
December	...	97.0	...	75.6	...	109.5	...	70.0	...	7.07	...	15	...	do
1931														
January	...	92.0	...	73.1	...	98.5	...	72.0	...	6.22	...	17	...	do
February	...	92.8	...	76.0	...	98.0	...	71.5	...	5.53	...	17	...	do.
March	...	92.4	...	74.1	...	99.5	...	68.0	...	1.85	...	9	...	do. but inadequate
April	...	90.0	...	70.5	...	99.0	...	58.0	...	3.03	...	11	...	Rain ineffective 2.64 ins. in 1 day 0.39 ins. over 10 days
May	...	88.7	...	66.4	...	98.0	...	57.5	...	0.23	...	3	...	Ineffective } at least 2-3 ins.
June	...	80.9	...	58.5	...	88.0	...	47.0	...	0.99	...	9	...	Mostly do. } of effective rain
July	...	83.2	...	59.2	...	92.5	...	53.0	...	0.27	...	1	...	Effective } reqd. to induce second flush on cotton plants.
August	...	90.1	...	62.4	...	101.0	...	56.0	...	nil	...	nil	...	
September	...	94.7	...	66.0	...	106.0	...	51.5	...	nil	...	nil	...	
October	...	100.0	...	72.9	...	109.0	...	68.0	...	1.01	...	3	...	Effective
November	...	95.3	...	74.9	...	105.5	...	71.0	...	1.05	...	3	...	do.
December	...	92.4	...	74.3	...	104.5	...	70.5	...	1.15	...	18	...	Approx. 75 per cent. effective

Total seasonal rainfall—November 1930 to October 1931—27.02 ins.

Total yearly rainfall—1931—24.63 ins.

Seasonal notes on crops.—*Machewere* good; *mapira* failed; insect attack and dry March. Cotton planted after February gave poor yields or none at all. Early planted in January and early February good in Lower Shire district. Good maize on *dimbas*.

Table No 2.

PORT HERALD, CHIROMO AND CHIKWAWA RAINFALL, 1930-31.									
	Port Herald		Chiromo		Chikwawa				
	in.		in.		in.				
1930									
November	...	0.82 (4)*	...	0.98 (8)	...	2.26			
December	...	7.07 (15)	...	1.59	...	1.83			
1931									
January	...	6.22 (17)	...	6.82 (10)	...	6.93			
February	...	5.53 (17)	...	7.57 (13)	...	7.22			
March	...	1.85 (9)	...	1.23	...	2.61			
April	...	3.03 (11)	...	0.32	...	2.71			
May	...	0.23 (3)	...	0.23	...	0.08			
June	...	0.99 (9)	...	0.57	...	1.06 (5)			
July	...	0.27 (1)	...	0.32	...	0.11 (1)			
August	...	Nil	...	Nil	...	Nil			
September	...	Nil	...	Nil	...	Nil			
October	...	1.01 (3)	...	0.60 (3)	...	0.69 (2)			
November	...	1.05 (3)	...	0.60	...	0.73 (3)			
December	...	4.45 (18)	...	8.33 (7)	...	10.11 (12)			
		24.63 (91)	...	26.59	...	32.31	Yearly totals 1931		
		27.02 (89)	...	20.23	...	25.56	Seasonal totals, Nov. 1930 to Oct. 1931		

* Number of days of rain in brackets.

Report of the District Agricultural Officer, North Nyasa.

During the year further work in the investigation of the crop possibilities of the district and the improvement of the rice crop and industry has been carried out and in conjunction with this duty suitable agricultural propaganda, educational and advisory, has been undertaken on behalf of the native in his village planting areas. I should like to thank Messrs. The African Lakes Corporation who have been so helpful in affording the use of a small acreage on their Karonga Estate for experimental purposes and also for a further small area situated on the Ngerenge rice flats nine miles to the north-west of Karonga for the same purpose. No rental is charged by the Corporation for the land in question. To the district administrative staff I am indebted for their active interest and ready co-operation in all matters agricultural to an extent which has proved no small asset in the endeavours put forth to advance native agriculture, especially amongst a people so conservative in ideas as the Wankonde.

METEOROLOGICAL.

The seasonal rainfall, November 1930 to May 1931, registered at Karonga was 59.65 in. This was 5.75 in. above the average precipitation over the last four years. The details are as follows:

Month				Rainfall in inches	Number of days on which rain fell		
November	...	...	...	.79	...	...	—
December	...	...	...	5.90	...	...	7
January	...	...	...	8.18	...	...	17
February	...	...	...	18.88	...	...	12
March	...	...	...	23.07	...	...	21
April	...	...	...	6.76	...	...	13
May	...	...	...	1.57	...	...	4

CROPS: GENERAL.

Native food crops throughout the 4,384 square miles of the district were as a whole good. The extension of pulse cultivation in a better relationship to maize is desirable and this is receiving attention by the usual propaganda methods. Green gram (*Phaseolus Mungo* var.), for instance, might be more widely cultivated with advantage and the Tepary bean might also prove worthy of extension after trial.

An effort will be put forward to foster interest in the Soya bean and a quantity of seed of the *O-too-tan* variety has been introduced for free distribution to a number of selected natives. It is hoped that the native will take full advantage of the facilities offered to him, for the food value of this bean will be realised the more so when it is understood that, although North Nyasa is rich in cattle, it is unfortunate that but few animals are slain for consumption. Actually stock owners regard their cattle in the light of hoarded wealth and largely as a means of obtaining wives. Milk is of course consumed though no doubt the ghee industry has reduced the amount available for human consumption and incidentally calves have doubtless likewise suffered to a certain extent through a curtailed supply of material sustenance as a result of this enterprise.

COTTON.

On account of the depressed state of the market, cotton grown at approximately 700 miles from the coast cannot be a sound economic proposition and there has therefore been no native cotton-growing industry this season nor does it appear desirable to foster interest in the crop in 1932 under present circumstances. In the meantime the crop is not being neglected and varietal and other trials are in progress on the experimental plots at Karonga, representing summer cropping conditions, and at Kasisi under winter cropping conditions. All information obtained which has practical application will be applied immediately circumstances are favourable for a re-establishment of the industry.

Strains U4/5 and G.C. 664 have been tried out this season from seed supplied by the Empire Cotton Growing Corporation and with a view to building up seed supplies isolated plots of these strains were grown by Mr. Wm. Maxwell of Nyungwe Estate, Messrs. The African Lakes Corporation on their Karonga Estate and Mr. A. Harvey at Vua Farm. Thanks are due to all three parties for their generous assistance and co-operation in this connection.

The yields from the foregoing are of general interest and are tabulated below.

U4/5		G.C. 664	
7 acres	937 lb. lint	8 acres	816 lb. lint
10 acres	6,396 lb. seed cotton.	10 acres	5,951 lb. seed cotton
2.9 acres	2,637 lb. seed cotton		

RICE.

This crop has received considerable attention and study during the year.

Historical and general.—We have the followers of the Arab Mlozi to thank for the first introduction of rice into the district, the proximity of Tanganyika Territory for introduction of new varieties from time to time by North Nyasa natives who have journeyed through the rice-growing areas of that country, and the Indian trader in recent years for in some small measure setting a value upon quality.

Varieties.—In the main rice-growing area of the Ngerenge-Lufira-Tsongwe flats ten varieties of rice are represented in native cultivations and in no case does one of them appear to be a true aquatic rice in the strictest sense of the term though it may be that some have been evolved from what were originally aquatic types. Observations were made upon native rice cultivations and the following brief notes on varieties are included, as per table, but these should not be taken as in any way conclusive or complete. They are the result of preliminary observations and will be confirmed, modified and elaborated as found necessary at a later date after a more exhaustive study can be made on the experimental area now established for that purpose.

Variety	Age in days?	Computed acre yield unhulled rice in lb.	Percentage unhulled rice to head	Percentage cleaned and sound rice to unhulled rice	Type
1. Faya ...	150	600	92	75	aquatic
2. Msafili ...	142	1,281	92	75	upland
3. Bungala mgeni	134	1,630	87	75	aquatic
4. Chimoto ...	150	600	86	75	aquatic
5. Malula ...	155	2,016	86	75	upland
6. Bungala ...	155	Pure seeding not obtained	86	75	aquatic
7. Malya ...	135	950	80	69	upland
8. Mele ...	? 90	190	80	63	—
9. Majukunua ...	105	560	80	63	upland
10. Mwakilima ...	135	2,948	80	69	upland

Tendency to lodging appears to be found in all varieties when conditions of growth are sufficiently luxuriant.

Whilst *faya* is of outstanding merit as a white rice, *mwakilima* is the least attractive of all from a market standpoint. An interesting correlation exists between figures obtained from native rice cultivation in South and North Nyasa, as shown below.

	North Nyasa.	South Nyasa.
Average acreage native rice cultivation	382 acres	320 acres
Average yield unhulled rice per acre	... 1,077 lb.	... 1,004 lb.
Average production per native cultivation (cleaned rice)	296 „	231 „

Improvement of the crop.—The native sows his rice broadcast and, in the immediate past, with little or no attention paid to sowing a pure seeding of any one variety. It is small wonder therefore that with so many varieties mixed stands with consequent uneven ripening were much in evidence and as a result a mixed product of low commercial value the obvious outcome. This had not been realised hitherto by the grower who until 1930 had not received any helpful advice regarding this crop. It is gratifying to be able to report that following on agricultural propaganda commenced by the District Agricultural Officer in 1930 a distinct tendency to favour pure seedings of any one or other variety has been observed and this, coupled with advice as to correct time of harvesting with its beneficial effects on hulling together with later instruction in preparation of the rice for market, has brought about the great improvement in quality of the product that was available for sale this season.

The elimination of what prove to be inferior and undesirable types must follow and in this move the sympathies of the grower must be enlisted by demonstrating to him the all-round superiority of whatever variety or varieties are found to be most suited to conditions of soil and climate as well as to market demands. Apart from the itinerant educational work referred to, mass-selections have been made from native cultivations of all ten varieties and these will be closely followed out experimentally during the coming season on the Kasisi Plots.

Marketing of the crop.—When the native hut tax was 4/- two 60 lb. bags of rice were accepted in certain districts in lieu of tax, and later when the tax was raised to 6/- a tax receipt was, until a few years ago, obtainable for exactly the same amount of rice that had previously sufficed for the lower tax. This practice undoubtedly had the effect, in the first instance, of fixing upon the native mind the price of this commodity at 2/- per 60 lb., and then, without any regard to improvement in quality, automatically raised it to the rate of 3/- per 60 lb. It was at this latter rate the bulk of the crop was disposed of in previous years, and, so far as I am aware, no attempt was made towards grading or improvement although occasional small quantities of fair quality white rice, usually of the varieties *faya* and *msafili*, found a ready sale to Indian traders at the premium rate of 4/- per 60 lb.

At the end of 1930 it was announced that rice for Government requirements would be bought at the rate of 4/- per 60 lb. and the opportunity was taken to apply the new and higher rate to first-grade rice only. A definite value was thus placed on an improvement of quality. Grades containing red, mixed and broken grain were purchased at the old rate of 3/-, and to avoid hardship to the grower, an intermediate grade of white rice containing only a small proportion of broken grains was bought at 3/6. Demonstrations of grades were given and samples of grades were distributed to various centres. The grower was thus prepared for a change in marketing conditions. Results were entirely satisfactory and it is felt that a step in the right direction has been taken. The percentage of No. 1 quality that found its way to the Karonga market, a trifling quantity in the past, was very encouraging.

Allowing that the grower himself consumes 50 per cent of the crop, the estimated production for the year was 479,160 lb. of which 239,580 lb. were disposed of for £669 7s. 6d. as shown below :

Purchased for consumption within North Nyasa.			Purchased for export out of North Nyasa.		
No. 1	No. 2	No. 3	No. 1	No. 2	No. 3
22,320 lb.	18,660 lb.	62,580 lb.	41,100 lb.	28,520 lb.	71,400 lb.
Total No. 1	68,420 lb. = 26 per cent of crop ; valued at £211 8s. 0d.				
Total No. 2	42,180 lb. = 17 per cent of crop ; valued at £128 0s. 6d.				
Total No. 3	133,980 lb. = 57 per cent of crop ; valued at £334 19s. 0d.				

GROUNDNUTS.

As the outcome of a soap manufacturing enterprise on the part of Mr. Maxwell of Nyungwe Estates and the necessity for supplies of oil, a small local demand for groundnuts has arisen and during the season natives were thereby enabled to dispose of this commodity to a total of 41,280 lb.

A further inducement to the extension of native cultivation of this crop is the not remote possibility of an invasion of the district by the migratory locust (*Locusta migratorioides*) which has threatened our borders since the month of June. In this connection the native has been advised to increase his acreages under the various food crops belonging to the dicotyledon class in order that his food supplies may be made reasonably secure should the migratory locust put in an appearance and attack, as it would, maize, millets, rice and other plant life of the monocotyledon class upon which it feeds. Every opportunity is taken to advertise the beneficial results to health of improving native diet by the inclusion of a highly nitrogenous food as an *ndiwo* to the staple porridges of maize and flours, and it is hoped that this will help to ensure the inclusion of groundnuts in every native cultivation where soil conditions are favourable.

COFFEE.

An agricultural survey of the Upper Henga Valley (Nyika influence) was carried out during the year and formed the subject of a detailed report in which I was able to render a favourable account of the possibilities of native coffee culture there. The possibilities are limited by the extent of suitable soil but they are worthy of further investigation and they justify future trials in plots.

EXPERIMENTAL WORK, STEVENSON PLOTS, KARONGA.

This area served the ideal use to which such a station should be devoted in that it provided for experimentation and demonstration.

Groundnuts.—The varieties represented in the comparative trials carried out were Fort Johnston selection (*nteza wenandi*), an Empire Cotton Growing Corporation selection (*chimbivila*), the local Karonga nut (*miyowa*), *Spanish Bunch*, and *basse*, an introduction from the Gambia which promised well when tried at Ntumbwasi in 1928. A summary of results from the nine-times replicated plots under each variety is given below.

Variety	Spacing	Days to maturity	Calculated yield of unshelled nuts per acre	Percentage kernels to nuts	Calculated average yield per acre at F. J. Station 1929
Basse	2' x 1'	166	2,428 lb.	75	928 lb.
F. J. Selection	2' x 1'	166	2,364 lb.	75	1,071 lb.
E. C. G. C. Selection	2' x 1'	166	2,120 lb.	69	913 lb.
Karonga Miyowa	2' x 1'	166	1,600 lb.	69	—
Spanish Bunch	2' x 1'	110	1,315 lb.	69	550 lb.

The crop did well in all cases as the results indicate. In the early stages of growth some damage was caused through heavy attack upon both seed and seedlings by a species of the family *Julidae*. These pests were eradicated from the crop by dusting lime along the planting lines and eventually a full stand with complete ground cover was obtained.

Simsim (*Sesamum indicum*).—The yields obtained from local seed on the four-times-replicated 1/100th-acre plots under this crop gave a calculated average acre yield of 500 lb. per acre. This is considerably above the average yield obtained in India. A 3 lb. sample of the seed used in this trial was forwarded through the department to the Mazabuka Research Station, Northern Rhodesia, late in 1930. The yield capacity of this seed is good but it is unfortunate that it is rather a mixed sample and requires improving.

Green Gram (*Phaseolus Mungo* var.).—This crop was planted at a spacing of 2 ft. by 1 ft. on two planting dates with a month interval between each planting which was represented by four 1/100th-acre plots. The March planting gave a calculated yield of 750 lb. per acre while the April planting gave a calculated yield of 300 lb. per acre.

The crop was attacked by a fungus disease caused by a species closely related to *Heterosporium*. This disease appeared largely on the leaves of the plants and was most prevalent in the case of the second planting and this, no doubt, contributed to the lowered yield obtained although season of planting had a bearing on this as well as on the appearance of the disease itself. It was noted that the stainer *Dysdercus intermedius* and a *Pentatomid* bug (species unknown) were much attracted to the plants and undoubtedly facilitated the spread of the disease.

Chindumba (*Echinochloa frumentacea*).—Produced only at the rate of 140 lb. to the acre as against a top yield of 1,700 lb. per acre and a bottom yield of 490 lb. per acre obtained in previous years at Fort Johnston. The low yield obtained is attributed to a heavy attack of the fungus disease *Ustilago panici-frumentacei* which had hitherto not been observed attacking it. Depredation by birds was also severe.

Maize.—Comparative trials of *Potchefstroom Pearl* and *Karonga Local* were made, each variety being replicated ten times. Excellent single plant stands at 4 in. by 15 in. were obtained and growth was good and uniform. Yield returns were as per table below.

Variety		Yield per acre		Shelling per- centage		Seed yield per 100 cobs
Potch. Pearl	...	1,956 lb.	...	68	...	32 lb.
Karonga Local	...	1,918 lb.	...	63	...	25 lb.

Shelling percentages were made from unstripped cobs. It will be noted that *Potchefstroom Pearl* had but little advantage over the native maize other than a slight pull in shelling percentages and seed production to cob. It was of course of higher grade.

A short term maize called *kafura* is grown by a few natives in this district. Two crops are usually taken in the period from the break of the rains in December up to the establishment of the dry season proper. It averages about 5 ft. 6 in. in height. A 1/100th-acre plot planted on March 16th. took 90 days to reach full maturity and produced at the rate of 1,000 lb. per acre seed maize approximately. Selection work on this maize might be taken up with advantage. A sample of seed has been sent to Zomba for multiplication.

Finger Millets.—This crop is singularly popular with the beer-loving natives of this district. Trials of the local variety *malesi* and the early-maturing variety *kangumba* from South Nyasa gave the following results in plots replicated five times.

Variety		Age at maturity		Yield per acre		Threshing percentage
Malesi	...	150 days	...	1,370 lb.	...	70
Kangumba	...	105 days	...	1,764 lb.	...	66

The planting procedure was that of the nursery and transplanting method, i.e., young plants of about 6 in. in height were planted out at a spacing of 18 in. by 18 in. under suitable weather conditions. This method simplified the keeping down of weeds in the earlier stages of growth and the stand is more uniform in density than when the more commonly employed broadcasting method is adopted.

Cotton.—The strains under observation in $\frac{1}{4}$ -acre observation plots were *U4/5*, *Cambodia G. C. 664/1* and *Over-the-top*. The crop was grown on the ridge. In the summer planting on the Stevenson plots the following results were obtained.

Calculated yield of seed cotton per acre.

Planting dates		U4/5		G. C. 664/1		Over-the-top
29/12/30	...	1,482 lb.	...	704 lb.	...	1,012 lb.
29/ 1/31	...	1,812 lb.	...	940 lb.	...	1,212 lb.
2/ 3/31	...	1,420 lb.	...	996 lb.	...	676 lb.

The yield return of *U4/5* is of outstanding merit throughout although none of the yields obtained can be classed other than well above high average with perhaps the exception of the March planting of *Over-the-top*. Bulk pickings occurred as follows: December planting, mid-May to mid-July; January planting, June to mid-August; March planting, October. G. C. 664 was latest in bearing in each case.

Daily pickings of all pests in each of the $\frac{1}{4}$ -acre plots were made from the month of March and this work would have commenced earlier in the season had the necessary labour been available. The figures obtained are as per table.

1st Planting 29th December.	Leaf roller Pyrallid larvae.	Stainers.	Bollworm moths Diparopsis.	Earias.	Bollsuckers.	Percentage of shedding attributable to bollworm.
March	197	320	8	1	13	—
April	326	324	—	—	30	figures lost
May	23	962	4	—	79	figures lost
June	3	1,871	2	—	60	49
July	—	1,616	6	10	22	37
August	—	978	—	9	3	35
September	—	1,164	—	—	1	39
October	—	397	1	—	—	31
2nd Planting 29th January						
March	61	163	1	—	5	—
April	209	420	—	—	8	—
May	54	798	17	—	24	—
June	6	1,628	14	4	53	63
July	—	1,230	8	4	10	43
August	—	938	—	2	4	36
September	—	1,115	2	1	—	39
October	—	619	—	—	—	34
3rd Planting 2nd March						
April	166	6	2	—	2	—
May	97	375	18	1	28	—
June	4	1,020	7	2	2	77
July	—	773	4	—	4	44
August	—	789	1	—	8	36
September	—	810	1	2	—	37
October	—	642	—	—	—	30

Each planting represents three plots to a total of $\frac{3}{4}$ acre picked over daily. Stainers include *Dysdercus intermedius* and *Dysdercus nigrofasciatus*. Other insects observed on cotton were the Assassin bug (*P. honoictomes nigrofasciatus* Stal.) and several species of Coccinellid beetle.

Jassid appeared in late February but little at all was seen after the end of April and, judging from the amount of leaf reddening shown by the varieties under trial, it would appear from general observations that in the first and second plantings (dated 29/12/30 and 29/1/31 respectively) *U4/5* and *G. C. 664/1* proved most resistant to attack and *Over-the-top* least resistant. In the third planting (2/3/31) *Over-the-top* revealed marked leaf reddening by early July whilst *U4/5* and *G. C. 664/1* showed least tendency to that condition.

Field rats play considerable havoc with field cotton in this district and it was ascertained that a loss of $6\frac{1}{2}$ per cent. occurred in stored seed cotton during a period of six months. Losses in the field from this pest must be even higher when it is realised that, using four traps to the acre, 2,640 rats were caught amongst the crop in one month of trapping operations and 273 in the cotton store during the same period.

In the winter planting in the Kasisi plots the three strains already mentioned were repeated on $\frac{1}{2}$ -acre observation plots planted under dates as per yield table below.

Planting dates		Calculated yield of seed cotton per acre					
		U4/5		G. C. 664/1		Over-the-top	
7/4/31	...	144 lb.	...	144 lb.	...	196 lb.	
1/5/31	...	204 lb.	...	192 lb.	...	188 lb.	
20/5/31	...	164 lb.	...	68 lb.	...	172 lb.	

These low yields do not fairly indicate what is possible under the soil and climatic conditions which this area represents and are mainly the result of the preparatory clearing and cultivation not having taken place sufficiently early; unfortunately this was unavoidable. Other adverse circumstances were damage caused through game whilst monkeys and field rats also took their toll.

The staff at my disposal was inadequate to effect daily counts of insect pests similar to those carried out on the Stevenson Plots but I was able to check up the percentage of shed flowers, buds and bolls which indicated boll-worm attack.

1st planting 7/4/31			2nd planting 1/5/31			3rd planting 20/5/31		
July	...	66	July	...	69	July	...	—
August	...	62	August	...	60	August	...	64
September	...	51	September	...	33	September	...	33
October	...	34	October	...	32	October	...	31
November	...	27	November	...	29	November	...	29

Bollworms (*Diparopsis* and *Earias*) first appeared in June. Other pests present were *Jassid*, *Aphis* and stainer, the last in but minor numbers. Areolate mildew leaf disease (*Ramularia areola*) which made its appearance in late June was much in evidence.

The work in the coming season will continue to deal with cotton, oil seeds and native food crops and to meet the requirements of experimentation a completely new layout of both the Stevenson and Kasisi Plots to allow of the Latin square arrangement has been effected.

FRANK BARKER
District Agricultural Officer.

Report of the Assistant Director and Agricultural Chemist.

The work for the year 1931 can be divided into:—

1. Meteorological and soil investigations,
2. Supervision of field experiments and seed production,
3. Tobacco inspection, i.e. (a) co-operation with the Native Tobacco Board and (b) inspection of estates of planters receiving Government assistance,
4. Extension services, i.e., personal visits to estates,
5. Crop observations, including the trial of numerous legumes for cover crops and green manuring and the incidence of diseases on tobacco under varying conditions,
6. Miscellaneous, including work on (a) dips (b) stomach contents (c) poisons.

Much of the above work has to be carefully dovetailed together. It will be at once apparent that meteorological observations, together with soil studies, have a most important bearing on crop observations. The determination of the suitability of species or varieties to certain localities may be of little use unless it is known that such crops are eventually to take their place in the permanent agriculture of large areas of the country. Furthermore, the attempts which are being made to retard the all too rapid deterioration of large areas of Nyasaland are concerned with the trial of ridge-terracing systems and with the maintenance of an optimum content of organic matter in the soil.

The improvement of the *Western DN* variety of tobacco, from which now practically all dark-fired Nyasa tobacco is produced, or the improvement of the *Cash* variety for flue-curing is likewise concerned not only with how the improved strains behave as regards quality on different soils but also with the incidence of disease, either starvation or parasitic, in the different strains. The above work in fact, involves the accumulation of records over a number of years for which sufficient time cannot always be found, but in which I have received valuable assistance from Mr. A. B. Cormack of the Native Tobacco Board.

1. METEOROLOGICAL AND SOIL INVESTIGATIONS.

Meteorological.—Books were obtained during the year for recording meteorological observations taken in the various districts. Averages of the figures for temperatures and humidity during the month are made and the rainfall figures are analysed for intensity. It is possible and convenient from the records collected to divide the country into eight zones, each of which is worthy of separate study from the standpoint of agricultural development. For example, the areas most suited to the production of tobacco are becoming much better defined and it is hoped that the Northern Province will one day produce flue-cured and air-cured in much larger quantities.

Soil work.—Considerable attention has been paid during the past year in the laboratory to the acidity of Nyasaland soils. It is perhaps unnecessary to mention that this aspect of soil science is one of the most important, involving as it does the solution of manurial problems and suitability of many soils to numerous crops. In these studies a large number of samples of surface soils and of different horizons of profiles of important soil series in Nyasaland has been examined for lime requirement, Comber colour and pH values. In the case of most samples from the lower horizons, the pH was alone determined.

It would be best to describe the methods used in these determinations. Determinations of pH values were carried out by means of the double quinhydrone electrode described by Cole together with a Cambridge Instrument Company portable potentiometer. The Siemens dry cell was standardized with a Weston cell. The usual agar bridges carefully prepared and stored in a saturated solution of potassium chloride were employed. After numerous determinations of various soil-water ratios it was decided to use the ratio 1:2.5 largely recommended. A small potential drift over a considerable period of time was observed in suspensions of this nature with most Nyasaland soils. The suspension was thoroughly agitated before determination and the reading was taken when no further change in potential was observed after considerable shaking. Further readings were taken of the suspensions after half an hour. The cell bridged with these suspensions was one whose electrolyte consists of a solution of .01 N hydrochloric acid and 0.9 N potassium chloride. This was frequently compared with a 0.5 N potassium phthalate cell. A solution of a definite pH made up with carefully prepared primary potassium phosphate and secondary sodium phosphate was used from time to time to check the accuracy of the electrode. Colorimetric determinations of the pH were also made for comparison using the drop method with brom-cresol-purple as indicator.

Normal and exchange acidities were determined on most samples, the latter being determined in soil suspensions in N/5 potassium chloride solutions. The lime requirement was determined by the method of Hutchinson-McLennan, 20 grams of soil being shaken with 250 c.c. of approximately N/50 solution of calcium bicarbonate for three hours in the usual way. Comber colour was determined by shaking the soil with a freshly prepared solution composed of 60 per cent. pure methyl alcohol and 40 per cent. acetone containing 5 per cent. potassium thiocyanate in a small

test-tube, settling and using arbitrary standards from 0 to 6, i.e., 0 for a colourless suspension and 6 for a blood-red one. Only liquids having uniform composition and acidity were used in making up the reagents.

The following points were elucidated during these studies: (a) The relationship between lime requirement, Comber colour and hydrogen ion concentration of extracts of surface soils,

(b) Comparison of the pH values of soil-water mixtures with the climatic conditions under which soils were formed, with special reference to virgin and tea soils,

(c) Drift in potential of the quinhydrone electrode, the gradual change in the measured pH value of the soil being noted for different profile samples,

(d) Distribution of acidity with depth.

For comparison a range of determinations of pH values of soil-water suspensions and an average of a number of Comber colours are given for corresponding soils.

Table 1.

pH values	Average of No. of Comber colour			No. of soils taken
8 — 7.5	...	.06	...	4
7.5 — 7.00	...	.24	...	17
6.99 — 6.76	...	.83	...	18
6.75 — 6.50	...	1.31	...	26
6.49 — 6.26	...	1.43	...	22
6.25 — 6.00	...	1.93	...	14
5.99 — 5.75	...	2.50	...	9
5.75 — 5.50	...	2.79	...	5
5.49 — 5.25	...	3.08	...	3

There is a connection between the pH value and Comber colour of soil-water extracts. It is unnecessary at this stage to work out a standard error of the mean but it may not be out of place to mention that the use of the Comber thiocyanate test can be recommended for rough field tests. Certainly, as will be seen, a good tea soil invariably gives a colour with the thiocyanate solution.

A comparison between the range of a number of determinations of pH values and an average of the figures within that range of lime requirements is also given here.

Table 2.

Range of pH values	Average lime requirement per cent.			No. of soils taken
8 — 7.5	...	.088	...	3
7.49 — 7.00	...	.081	...	17
6.99 — 6.76	...	.084	...	14
6.75 — 6.50	...	.105	...	23
6.49 — 6.26	...	.113	...	30
6.25 — 6.00	...	.126	...	23
5.99 — 5.76	...	.148	...	10
5.75 — 5.50	...	.120	...	4 only

Here again there is obviously a connection between such values for carbonate-free soils. There are of course exceptions to the above, as can be seen at the bottom of the column, but doubtless an explanation can be offered for such variations from agreement.

The exchange reaction of numerous soils was also determined by various methods in the course of these studies. Readings taken half an hour after thoroughly agitating soil-water suspensions in ratios 1: 2.5 and 1: 5 of both molar potassium chloride and M/5 potassium chloride were with few exceptions identical. Centrifuging such suspensions made negligible difference to the results. It can only be repeated that the reaction of numerous soils in areas with normally a high rainfall is likely to be an important factor in determining their suitability or otherwise to the production of certain crops with profitable yield, both from the point of view of weight per acre and of the quality obtained.

Reaction of Nyasaland tea soils.—It is often maintained in studies of tea soils that the general pH or reaction range for good tea soils is from 4.5 to 6.0 for the soil-water suspension and for a neutral salt extract, i.e., the exchange reaction range 3.5 to 5.5. The range of specific acidities for such figures is in the first place 316 to 10, a very wide range, and in the second place, 1,800 to 51.5 another considerable range. Dr. Mann prefers the pH value of a soil-water extract of a good tea soil to be under 5, i.e., to have a higher specific acidity than 100. This is a well-defined point on the curve given by plotting reaction values against specific acidities, and it is reasonable to suppose that a crop which is sensitive to soil acidity or prefers an acid soil would give a large difference in yield on soils whose pH or normal reaction values are greater than 5 as compared with the yields given on the good tea soils mentioned. This is confirmed by the experiments on the influence of soil reaction on the growth of young tea carried out in Java.

The question now arises as to the suitability of Nyasaland soils in areas with high rainfall to growing tea with the prospect of a good yield and a high commercial value. The reaction values of soils from Central Cholo and from near Mlanje Mountain are seen in the accompanying tables

3 to 6. They indicate that schemes of manuring in those areas with lower rainfalls should be worked out so that the reaction value should be kept as near the optimum as possible; that is to say, fertilizers which do not reduce soil acidity should be largely used. Correct applications of organic matter should have a prominent place in such schemes.

Table 3

District	No. of soil	Mean annual rainfall in inches	Reaction pH		District	No. of soil	Mean annual rainfall in inches	Reaction pH	
			normal	exchange				normal	exchange
C= Cholo					C= Cholo				
M= Mlanje					M= Mlanje				
C	162	48	6.46	5.44	M	V523	68	6.16	5.50
C	V164	48	7.02	6.50	M	V525	60	6.01	5.25
C	166	48	6.65	5.99	M	S526	60	5.92	5.00
M	V263	50	6.69	5.80	M	527	60	6.77	6.09
C	265	52	7.35	5.89	M	S528	60	6.40	6.06
C	441	48	6.61	5.88	M	531	58	6.71	6.20
C	S442	48	5.80	5.01	M	532	58	7.15	6.37
C	449	48	6.18	5.61	M	535	58	6.75	5.99
C	S450	56	5.49	5.20	M	S536	53	7.42	6.91
C	451	58	6.40	5.33	M	539	76	5.26	4.49
C	452	58	5.98	5.18	M	543	74	5.58	4.85
C	453	58	6.70	6.09	M	S544	74	5.39	4.56
C	461	48	6.30	5.48	M	545	74	5.20	4.41
C	V463	49	6.83	5.72	M	S548	74	5.49	4.33
M	521	68	5.39	4.74					

Table 4

No. of soil	Mean annual rainfall	Lime requirement	Comber colour	Reaction		No. of soil	Mean annual rainfall	Lime requirement	Comber colour	Reaction	
				normal	exchange					normal	exchange
V101	48	.158	4	6.24	5.22	366	55	.106	1½	6.42	5.53
107	48	.030	1	6.21	5.64	V371	46	.074	0	6.91	5.80
112	56	.106	1½	6.20	5.84	V439	48	.10	0	6.67	5.55
V113	56	.182	2	6.33	5.88	461	48	.077	1	6.30	5.48
V169	56	.15	3	6.83	6.08	463	49	.049	0	6.83	5.72
V172	53	.08	0	6.90	6.63	V701	55	.12	2	6.18	5.65
V173	53	.14	0	6.56	6.24	V703	57	.16	2	6.21	4.92
V208	51	.101	2	5.93	5.20	222	70	.126	5½	5.06	4.88
228	45	.049	0	6.90	6.02	223	70	.128	0	5.45	5.20
283	48	.077	3	6.51	5.75	227	70	.154	3	5.55	4.68
V284	48	.105	1	6.59	5.82	257	52	.22	1	5.82	—
286	48	.102	0	7.24	6.19	258	52	.29	2½	5.33	4.85
288	48	.056	2	6.78	6.15	413	60	.175	1½	6.91	5.10
V290	48	.063	0	6.95	6.12	135	52	.22	5	6.34	5.60

NOTE.—The last seven are from Mlanje; the remainder are from Central Cholo.

Table 5

Reaction values of horizons of Cholo soils.				Reaction values of horizons of Cholo soils.			
No. of soil	Mean annual rainfall	Lower depth inches	Reaction (normal) pH	No. of soil	Mean annual rainfall	Lower depth inches	Reaction (normal) pH
964V	57	9	6.27	1086	45	30	6.26
965V	57	18	5.49	1087	45	42	6.21
966V	57	9	6.51	1088	45	54	6.09
967V	57	18	6.49	1089	45	72	6.25
1074	48	9	5.64	1090V	45	9	6.50
1075	48	48	5.59	1091V	45	18	6.48
1078	48	121	5.84	1092V	45	30	5.97
1079	48	144	5.61	1093V	45	39	6.00
1084	45	9	6.78	1094V	45	60	6.06
1085	45	21	6.46				

Table 6

Reaction values of Mlanje soils.			Reaction values of Mlanje soils.		
No. of soil	Lower depth inches	Reaction (normal) pH	No. of soil	Lower depth inches	Reaction (normal) pH
955	9	4.75	1101	36	4.96
956	18	4.82	1102	48	5.04
957	9	4.69	1103	60	5.08
958	18	4.60	1104	72	5.15
960	9	5.17	1105	9	5.25
961	18	4.75	1106	9	5.01
962	36	4.81	1107	12	4.94
963	48	5.45	1108	18	4.93
V1096	9	5.28	1109	24	5.00
1097	9	5.18	1110	36	5.08
1098	12	5.11	1111	48	4.91
1099	18	5.08	1112	60	4.96
1100	24	4.98	1113	72	5.01

The study of soil profiles has been continued during the year. It will be seen from the tables presented for Cholo and Mlanje soils that when the pH values of samples taken from lower depths of undisturbed virgin soil are plotted against the depth, good curves are obtained and this is general for most red loam and lateritic soils. The highest acidity (lowest pH) is generally coincident with the depth at which there is a tendency to form a pan in all these soils. The inclusion of *nandolo* (*Cajanus indicus*) in rotations has been recommended on these soils (5). Its great value will be referred to later.

Results with samples from older cultivated lands generally show the highest point of acidity to be much nearer the surface. This is not surprising when the erosivity of red loam soils is considered and that often a layer of soil equivalent to one quarter of an inch over the entire surface of a measured area of land has been carried by the surface run-off in one season and collected in large pits.

It seems from a study of the profiles of many Shiré Highland soils that the humic layers are generally well supplied in the virgin state with lime and have a low hydrogen-ion concentration or are definitely alkaline. A few years in cultivation causes much change and the decrease in pH value from the humic to the sub-humic layers and to the subsoil is no longer shown. In most denuded areas with impoverished soil the profiles show a steady increase in pH values to considerable depths.

Further reports on the characterization of Nyasaland soils were received from the Imperial Institute during the year.

Studies of land and climate from the point of view of the establishment of experimental stations occupied much of my time in travelling during the year.

2. FIELD EXPERIMENTS AND SEED PRODUCTION.

A large part of my time was spent in superintending experimental field work and seed production on the plots at Zomba and Lilongwe which are financed by the Native Tobacco Board. Some interesting results were obtained in experimental work, the significance of which was worked out by the method of Dr. Fisher for the analysis of variance. The general object of the experimental work is to show how land can be maintained in fertility over a considerable number of years by means of rotations and a judicious and economical use of fertilizers, the influence of the latter on organic matter in the soil being particularly noted.

Attempts are made to utilize manures of an organic nature which can be obtained cheaply in the country such as kraal manure, cotton seed and groundnut cake. The use of green-manure crops has been the subject of much study, numerous species having been utilized. It is obvious that during our short growing season mistakes are frequently made in choosing the correct time for burying the green manure or in preferring such a disposal to harvesting for seed or to feeding off with cattle which may be definitely a better method in a dry season. The latter method was preferred during the dry months of February and March on certain plots.

Valuations of fertilizers and manure are made and are considered in the comparisons made. It is obvious that the organic manures mentioned above are very often much cheaper in unit value than highly concentrated fertilisers and, as has been often reiterated, they supply those minor elements of plant food such as magnesia and sulphur which are sometimes not contained in the new highly concentrated fertilisers. The danger of sulphur starvation in certain crops fertilised with highly concentrated fertilisers was mentioned some time ago (8).

It is perhaps unnecessary at this stage to describe the total experimental layout now being dealt with but the result of an experiment now quoted will impress upon growers that it is sometimes unnecessary to apply to certain soils a so-called complete fertiliser. As our results accumulate, I can prophesy that organic matter and the nitrogen it contains will be shown to be deciding factors in soil fertility of numerous soils. The loss of these soil constituents accompanied by bad farming is the explanation of the abandoned tobacco fields and barns frequently to be seen in the Southern Province.

EXPERIMENT WITH LIME AND DOUBLE SUPERPHOSPHATE IN A LATIN SQUARE PLOT LAY-OUT.

Variety of tobacco planted: *Western D. N.*

Size of plot: 1/40th acre.

Treatments: A. check plots

B. 2,000 lb. lime and 200 lb. double superphosphate per acre.

C. 2,000 lb. lime per acre

D. 200 lb. double superphosphate

Basal dressing: All plots received 90 lb. of sulphate of ammonia per acre.

Seed beds were sown from *J. Western D. N.* seed on 18/10/31 and were planted out on 20/12/30. All seedlings were healthy resulting in a very good stand and all made fair growth with very little eelworm infestation.

Table 7. Weights per plot.

Plot No.	1st picking 25/3/31			2nd picking 6/4/31			3rd picking 16/4/31			4th picking 4/5/31			Totals: all plots		
	G. W.	D. W.		G. W.	D. W.		G. W.	D. W.		G. W.	D. W.		Green wts.	Dry wts.	
1	...	27½	4½	...	36½	7½	...	15½	2½	...	58½	8½	...	137½	22½
2	...	31½	5½	...	65	9½	...	16	2½	...	47	6½	...	159½	23½
3	...	31	5	...	66	10½	...	7½	1½	...	21	3½	...	125½	20½
4	...	25½	4	...	59½	10½	...	5½	1	...	25	4½	...	115½	19½
5	...	33	4½	...	82	12½	...	9½	1½	...	32½	5	...	156½	23½
6	...	20½	3	...	53	8½	...	17½	2½	...	43½	8½	...	134	22½
7	...	30½	4½	...	67½	13	...	6½	1	...	45	7	...	149½	25½
8	...	20½	3	...	67½	11½	...	10½	1½	...	47	9	...	145½	25½
9	...	23½	3½	...	65	9½	...	19½	3½	...	44	6½	...	152½	22½
10	...	26½	4	...	55½	10½	...	17½	3	...	39½	6½	...	138½	24
11	...	27½	4½	...	74½	13½	...	9½	2	...	29½	4½	...	141	24
12	...	25½	4	...	65½	12	...	10½	1½	...	47½	6½	...	148½	24½
13	...	11½	1½	...	30½	5	...	6½	1½	...	77	12½	...	125½	20½
14	...	23½	3½	...	63½	12½	...	6½	1	...	35½	6½	...	128½	23½
15	...	20½	3½	...	56½	10½	...	10½	1½	...	45½	8½	...	130½	24
16	...	20½	3½	...	63½	10	...	6½	1	...	31	5½	...	121½	20½
G. W.=green weights D. W.=dry weights															

G. W.=green weights D. W.=dry weights

The results were examined for significance, and in the following table the results are tabulated. The standard error = .375 lb. From Fisher's table the value of the factor t is derived and is such that for any given value for n (in this case 6) the probability of the results being exceeded by chance in a hundred similar trials is less than 5 ($P = .05$)

Table 8.

Treatments	A	B	C	D	General mean	Standard error
Yields: average in lb. ...	23.50	22.06	23.44	22.88	22.78	.375lb.
Yield (mean 100 per cent) 103 ...	98	93	103	100.3	100	1.65lb.

Percentage standard error of any difference between mean treatment yields (criterion of significance) = $t \sqrt{2} \times 1.65 = 2.447 \times 1.414 \times 1.65 = 5.73$. This means that a numerical difference of 5.73 must occur between the percentage mean yields given in the above table before the difference in the effect of any two treatments can be said to be significant at the level of significance taken ($P = .05$). This difference does not occur. There is no significant depression or increase in yield due to the applications of lime or double superphosphate. There seems a slight depression in yield on plots B and D as a whole.

The problem was then attacked from another angle. The yields from the various plots were calculated to a perfect stand, that is to say, plants which died from insect attack or by accident were given a yield based on that given by the average plant in the plot which survived and reached full size.

Table 9. Actual stand by count.

Plot No.	Stand	Plot No.	Stand
1	99	10	92
2	100	11	99
3	94	12	98
4	86	13	99
5	100	14	90
6	99	15	98
7	87	16	91
8	97	—	—
9	98	—	—

Yields are here calculated to perfect stand (100 plants per plot).

Table 10.

Plot No.	lb.	Plot No.	lb.	Plot No.	lb.	Plot No.	lb.
1	22.98	5	23.75	9	23.30	13	20.96
2	23.75	6	22.98	10	25.92	14	25.85
3	21.47	7	29.09	11	24.24	15	24.48
4	22.25	8	26.01	12	24.99	16	22.07

The results obtained above were then statistically examined with the following results.

Table 11.

Treatments	A	B	C	D	General mean	Standard error
Yield average ...	23.86	23.30	23.74	25.12	24.01	1.04
Percentage yield mean = 100 per cent. ...	99.5	97.2	98.8	104.8	100	4.32
Criterion of significance = $t \sqrt{2} \times \text{S.E.}$						
= $2.447 \times 1.414 \times 4.32$						
= 15.1						

This analysis of the results also shows no significant difference between mean treatment yields. There seems to be a depression in yield on the limed plots.

The determinations of the significance of the results by the two methods is interesting and I maintain that with such a difficult crop as tobacco every effort should be made to obtain a perfect stand but where that rare event does not happen the weights of the various plots should be calculated to the number of plants necessary for a perfect stand.

The results of the experiment above might further be examined from the point of view of green weights or from the effect of the phosphate on ripening, but these can await the publication of the full records of experimental work.

The results of experiments given below were obtained. It cannot be said that the results attain that level of significance which is demanded by Dr. Fisher and his co-workers. Failure to obtain perfect stands, the loss occasioned by root gallworm and the extensive variation in soil between ridge terraces vitiated the success of some of these experiments with tobacco. Steps are taken to lessen these sources of error continually.

STUDY OF FORM OF NITROGEN SUPPLIED TO TOBACCO SOILS.

The four treatments were each given to four different plots arranged in a Latin square. It cannot be said during the season 1930-31 on the soil used that the nitrogenous applications have given any significant increase in yields. The significance of this experiment was spoilt by varying infection with root gallworm.

The variety grown was *Cash* and the plot lay-out was in the form of a Latin square.

Table 12. Yield per acre : average of four plots.

Plots	Treatment	Green weights	Dry weights	Calculated to perfect stand
A	Sulphate of ammonia ...	2,168	403	624
B	Nitrate of potash and sulphate of ammonia ...	2,683	435	599
C	Nil ...	2,705	490	659
D	Diammonphos ...	3,253	580	766

There is, however, an indication that the phosphoric oxide supplied in diammonphos does under the conditions of the above experiment give an increase in yield of flue-cured tobacco. This is also borne out by the following experiment with such tobacco.

EFFECT OF SUPERPHOSPHATE ON YIELD AND RIPENING OF FLUE-CURED TOBACCO.

Variety *Cash* receiving a basal dressing of 100 lb. of sulphate of ammonia per acre. Plot lay-out: Latin square.

Table 13. Yield per acre : average of three each.

Plots	Treatment per acre	Green weights	Dry weights
A	100 lb. double super ...	4,412	478
B	Nil ...	2,252	390
C	200 lb. double super ...	3,684	643

Yields per acre calculated to a complete stand.

Plots	Green weights	Dry weights
A ...	4,467	606
B ...	3,090	594
C ...	4,293	744

In this experiment, the ripening effect and increase in yield due to the double superphosphate at the rate of 200 lb. per acre were significant.

THE INFLUENCE OF ORGANIC MANURING ON THE YIELDS OF SMALL GRAINS.

Barley was sown in February. The season was too dry for a highly successful experiment but all the treatments have given significant increases in yield of straw over the untreated plots.

Table 14. Yield of small grains per acre

Plots	Treatment per acre	Yield per acre	
		Average of 5 plots : straw	Average of 5 plots : straw and grain
A	10 tons cattle manure ...	163	225
B	1,000 lb. cotton seed ...	182	229
C	5 tons cattle manure ...	170	213
D	Green manure ...	170	218
E	Control ...	136	185

Variety trials with tobacco and maize were also carried out during the year. The results with maize are given herewith but the trial with *Western DN* and *Lizard Tail* tobacco varieties was a failure. The basal dressing applied to the maize plots was cotton seed at 300 lb. per acre and urea at 80 lb. per acre.

Table 15.

Plots	Variety	Yield per acre : average of 9 plots.
A	Potchefstroom Pearl ...	2,123
B	Salisbury White ...	2,370
C	Yellow Flint ...	1,968 (eight plots)
D	Red Flint corn ...	670 (one plot only)

The yields given by the two first varieties are not significantly larger than those given by the *Yellow Flint* largely grown by natives.

Other experiments were carried out to study the effect of sulphate and magnesia on tea and tobacco. In the latter case *Harrison Pryor* was grown as this variety shows starvation phenomena very readily when sulphur and magnesia are deficient in the media in which it is growing. The variety under such circumstances often attains full size both in height and size of leaves, if the deficiency is light, but chlorosis is evident especially on lower leaves. It was seen in one row that application of sulphate reduced the chlorosis shown by ripe leaves. Fifteen leaves were left to each plant in order that soil deficiencies should be more evident. No difference could be detected in the small tea plots. The leaf from the various plots will be weighed next season.

It has been reported that tea often exhibits symptoms of *yellow*s on Zomba soils, even on those which have been lately opened up and on which there had been a good growth of grass and trees. The disease also occurs on land which has been manured with cattle manure and cotton seed. It is doubtful if tea roots find it more difficult to absorb certain elements than other crops, seeing that tea exists in thick bush in Zomba and is indigenous in Assam forests. There is still much work to be done on this disease.

Trials with soya-beans still show *O-too-tan* as the best yielder, to shatter in the field the least, and to retain its viability longer than other varieties.

Nandolo (Cajanus indicus) recommended as a deep rooting leguminous crop in the rotation (5) has proved itself of great value round Zomba and particularly on the experimental plots for restoring fertility and ameliorating the physical condition of red soils.

It is convenient at this stage of experimental work to record that *Adco* synthetic farmyard manure has been successfully made several times but that its preparation is uneconomical. Supervision is a serious item as it is necessary carefully to supervise the gangs bringing in bundles of grass and other organic matter, a very slow process in Nyasaland where native labourers are quite unaccustomed and unwilling to use tools which would ameliorate the tasks necessary.

Every effort is however made to maintain the optimum content of soil organic matter by green manuring and applications of kraal manure and cotton seed. Much bedding is used under the cattle in covered sheds so that little liquid manure is wasted. Altogether 60 tons of cattle manure were applied to the Zomba Experimental Plots during the year.

It is necessary again at this stage to record the difficulty of experimental work with such a crop as tobacco, especially with the trials of varieties. The difficulty of maintaining any strain constant in size, characters, etc., will be patent. Yield trials of any particular crop can be carried out with varieties of the crop or with a particularly good variety under varying conditions. Primarily it is necessary for the experimenter to satisfy himself that such trials are necessary and of importance in the development of agriculture as a whole under the particular set of conditions, cultural, soil and climate, with which he is concerned. It must be understood that results obtained under such conditions may not be of value to a very large part of the country he is living in. The general principle with tobacco to be borne in mind is that the acre-value may far transcend the mere acre-yield and that of two varieties one may give a 20 per cent increase in yield over the other which is the "local standard," this being a statistically significant result. When, however, the value of such leaf from the local standard is adjudged, it may easily be 16 per cent greater than that of the cured leaf from the other variety. The result may be reduced to an insignificant difference. Even when a certain variety during a four-year trial is found definitely superior to a local standard in the first three years, it may be found in the fourth year to succumb to bacterial disease while the standard remains comparatively free. The results obtained with a variety called *Hickory Pryor* will be fresh in the minds of many growers.

These aspects are quoted so that a series of yield trials may not be lightly embarked upon which as a minimum must be continued for three years. It is nowadays demanded in such experiments that large observation plots carrying varieties and different treatments must precede and accompany precision yield trials. With tobacco such plots have been carried on for a decade before it was decided to embark upon a series of precision trials under a set of conditions which are representative of large areas. It may be another decade before the results may be of sufficient significance to warrant publication. Furthermore, it may be necessary with certain crops to investigate the methods of plot management, the optimum plot size or the uniformity of soil in the experimental area.

All this points to a large amount of spade-work, especially large for a man who has numerous other duties to perform besides field work, and it is not surprising to see that a number of demonstrations only have been initiated in various countries. Examples are the fertilizer tests with flue-cured tobacco (Bulletin No. 12 of the United States Department of Agriculture, October 1927) or the grassland manurial trials carried out in England since 1920. It has been the practice of statisticians to decry the value of such tests as witness the remark that "yield trial figures should be accorded no credence, nor even be divulged, unless accompanied by evidence of statistical significance."

The obvious retort to the application of such a principle to tropical conditions is that in the history of a tropical industry (which might be the production of flue-cured tobacco) the agriculturist might be too late with his results and a definite decline might have set in before remedies could be suggested. The industry by then might have passed into the hands of another country. The difficulty in establishing an industry under tropical conditions and of maintaining the quality of high-priced products doubtless has been considered by the statisticians. The agriculturist, however, may often have to depend upon careful field observations and indeed may by that means point out where faults occur in cultural operations, soil management, and disease or pest control.

Let us consider for a moment two cycles of seasons in the more important tobacco areas of Nyasaland, i.e., 1913-1917 and 1925-1929. The average annual rainfall for the first five-year cycle was 32.736 inches and for the latter cycle 42.688. This difference of almost 10 inches makes a very big difference to the behaviour of the tobacco plant during the short growing season. Could experimental results during the former period be said to have value during the latter period? Doubtless uniformity trials or varietal trials might have given totally different results during the two periods. At any rate the incidence of certain diseases which were absent during the first period has made yields very different during the last period. In certain areas the tobacco produced seemed a totally different type. Without unduly detailing the demands which the tobacco industry makes upon the investigator, it will now be realized that varietal trials must be accompanied by varying soil treatments for each variety and that such trials must be repeated on the three or four principal soil types on which most of our Nyasaland tobacco grows.

Seed production was very satisfactory during the year and large reserves of tobacco seed are in hand for 1932. 255 lb. of *Western D. N.* and 60 lb. of *Cash* tobacco seed were produced on the Zomba Plots and issued for sale, mostly in the Southern Province. Seed of crops which are now regarded as suitable for covers, green manures, shade or rotations for certain areas was produced in quantity.

During the growing season, numerous measurements were made on tobacco plants grown from single-plant selections. The plants were eventually dressed to nine good leaves and measurements taken as in the examples given in the table, 950 plants being dealt with.

The ratio of length to width of the top middle leaf varies from 2.3 to 3.4, of the middle leaf 2.1 to 2.9 and of the bottom middle leaf 1.9 to 2.7. This range of variation is at present too great.

Table 16. Details of measurements taken of plants grown from single-plant selections.

		T. M. L.		Ratio L : W	M. L.		Ratio L : W	B. M. L.		Ratio L : W	Internode ins.	Height feet.	Original number of leaves.
		W.	L.		W.	L.		W.	L.				
J. largest	...	14½	36	2.5	17	36	2.6	17½	33	1.9	2½	5½	19
R. B. largest	...	9½	26½	2.8	10	26½	2.7	11½	28	2.4	2¼	3½	14
R. B. smallest	...	6	20½	3.4	7½	22	2.9	8¾	22½	2.6	2¾	3¾	19
R. B. average of 50		7½	23½	3.15	9½	24½	2.7	10	24¾	2.4	2½	3½	18
G. largest	...	13	36¾	2.8	15	37	2.5	17½	34	1.9	2½	5½	19
G. smallest	...	7½	22	2.9	9	26	2.9	11	24	2.2	2	3	17
H. largest	...	11½	30	2.5	11¾	30	2.5	13	32	2.5	2	4	18
H. smallest	...	7	20	2.9	8½	22½	2.7	10	23½	2.4	2	3	18
H. average of 50	...	10	29	2.9	10¾	28	2.6	11	27	2.5	2	3½	—
O. largest	...	13	33	2.5	11½	29	2.5	11	29½	2.7	2	4	18
R. largest	...	13½	32	2.3	12	30	2.5	11	29	2.6	2	4	19

From such studies it is possible to fix in one's mind the ideal plant for selfing from which the progeny can be subjected to extensive field trials. In addition, the venation, the surface of the leaf and the incidence of disease receive attention in all tobacco breeding work in Zomba.

3. TOBACCO INSPECTION WORK.

(a) Co-operation with the Native Tobacco Board involved the choice of plots for growing larger supplies of tobacco seed, alteration or improvement in various cultural operations such as topping, fertilising and curing, and the training of capitaos in field operations, 65 of whom attended at the Zomba Experimental Plots for varying periods.

(b) I inspected the estates of planters who received the Government grant. The crops were in certain cases disappointing owing mainly to bad weather but various faults prevented some of the planters from obtaining a good crop. These may be listed as (1) use of land which is seriously depleted of elements of fertility required for a good crop, (2) no provision of recognized methods of preventing soil erosion described by the department, (3) entire lack of rotations, (4) injudicious use of fertilisers or manures.

I dealt with an outbreak of tobacco beetle during the year during the absence on leave of the Entomologist. Tobacco had been stored from the previous year and several tons were fumigated with hydrocyanic acid gas.

4. EXTENSION WORK.

(a) An increasing number of planters is becoming interested in ridge terracing and a number of visits was made to instruct planters in the correct method of laying them off. It is becoming more apparent that the Mangum graded ridge is the most efficient instrument in preventing erosion on most tobacco land in Nyasaland, but proper storm drains are the first essential.

It may be convenient at this stage to reiterate the principles of terracing which have been accepted in Nyasaland. The vertical distance between terrace lines depends greatly upon the slope of the land. The following tabulation reiterates the distances which have been found to give the best results. They were given some time ago by the department (1).

Table 17

Slope of land in 100 feet			Corresponding grade			Vertical distance or drop between terraces.
2 ft.	...	...	1 in 50	...	...	2½ ft.
4 ft.	...	...	1 in 25	...	...	3 ft.
6 ft.	...	...	1 in 16	...	...	3½ ft.
8 ft.	...	...	1 in 12	...	...	4 ft.
10 ft.	...	...	1 in 10	...	...	4½ ft.

It is now generally conceded that the limit of slope for tobacco cultivation is 12 in 100. A drainage or other level is to be recommended for laying off all ridge terraces, a road tracer being only suitable for very small fields. The maximum length of a graded ridge terrace in any one direction should be 300 yards with a grade of 1 in 360. Of course the terraces may grade down in both ways from the middle of a field. Variable grades are not recommended for most tobacco fields. Level terraces are only to be recommended in small fields.

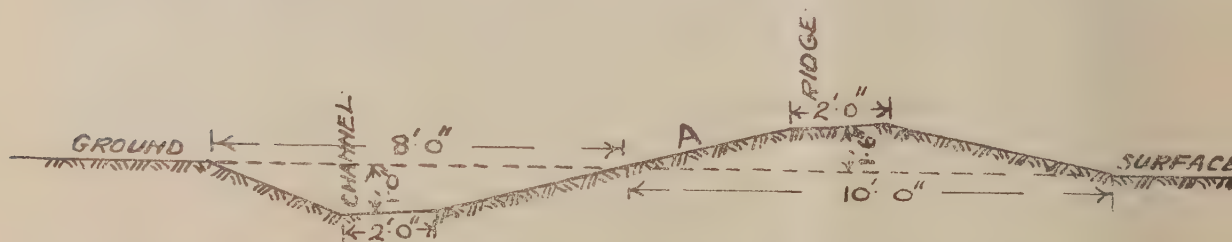
Failure of ridge terraces occurs commonly at sharp bends, at crossings of gullies and at points where an abrupt reduction in grade or size of channel has been made. Breaks are caused by water washing against the terrace and cutting through the embankment of earth and occur commonly where the terrace has considerable grade and where the water has a high velocity. No loose material such as stones or brushwood should be used in the construction of the terrace particularly when crossing a gully, which should be well dug before construction begins. At such places, the top of the terrace should be built up to the proper height and allowance should be made for the consolidation of the large amount of earth used. Revetting may be necessary and it is often necessary to seed a gully to grass or a cover crop.

It is found in the first year of laying out ridge terraces that the ridges for tobacco are advantageously made parallel to terrace lines. It generally takes four to five years to make an efficient broad-base Mangum terrace or a considerably longer period accompanied by much more expense to construct them on old land on which the soil has lost that optimum content of organic matter which so largely increases its absorptive capacity. Absorption by the subsoil is a very important factor in Nyasaland as so many subsoils are apt to form a pan or a crust of concretionary iron compounds which is almost impervious. Soil is moved both from the upper and lower side towards the terrace line either by hand, plough or ditcher.

The shape of the depression behind a ridge terrace should be as wide as is possible and compatible with retention of top soil over a large area. On old land silt pits are required in addition in the first few years at certain points and depressions. Soil accumulating behind the terrace is from time to time added to the ridge. The amount of water which is liable to accumulate behind ridge terraces depends on the amount of rainfall falling in a certain time on the slope and on the absorptive capacity of the soil. The latter is of the utmost importance. The term *contour drain* is not appropriate to a really efficient arrangement for minimising soil erosion. Contour dains generally involve a minute bank below an angular-sided ditch which is inefficient. It should be realized that in a few year's time with proper construction an efficient ridge terrace may have as broad a base as 10 feet.

It is doubtful if enough experience in most parts of Nyasaland has been obtained dogmatically to say that serious loss or depreciation of tobacco leaf is caused by "drowning" and silting up behind ridge terraces. It has often been seen in Zomba that some loss is experienced every year in this way but this is more than compensated for by the maintenance of soil fertility of the field as a whole. It is conceded that the depression must be deeper and narrower for tobacco than is generally recommended for other crops. There is really not a great difference between efficient shallow drains on a grade of 1 in 400 and some of the ridge terrace systems tried and in fact such drains have often been used as preliminaries to a terrace system (1).

A terrace with measurements as shown will in practice be capable of dealing with a storm of 3 inches of rain in three hours on practically any soil.



This caters for a poor absorption of soil of only 33 per cent, run-off being 66 per cent of the rainfall. The dimensions are practically the same as those which eventuate on many tobacco fields in Nyasaland. The angle of slope at A will be 33°.

Another arrangement adopted amongst permanent crops on steep slopes is to have a small level ridge terrace on the lower side of which a drain about 2 feet deep by 10 inches wide is provided. The use of cover crops in conjunction with such an arrangement does not however concern us here. The vertical distance between such level ridge terraces is as follows:

Table 18.

Type of soil	Vertical distance or drop between terraces.		
Sandy	...	...	4½ feet
Sandy loam	...	...	3½ feet
Clay loam	...	...	2½ feet
Clay ...	...	...	2 feet

If the slope is greater than 1 in 10, the vertical drop should be increased by half a foot. On the more gently sloping lands under permanent crops, however, there seems no reason why the broad-base graded ridge terrace should not be used with equal or more advantage.

(b) Efforts were made during the year to impress still further upon planters the necessity of using less concentrated fertilisers if they wished to obtain better quality. There is still a large amount of highly concentrated fertilisers used both on tea and tobacco without consideration either of the principles of good farming or of the necessity of avoiding various starvation diseases. Sand-drown or magnesia starvation is now most probably familiar to all tobacco planters although they may find it difficult to recognise mild cases. The deterioration in quality is however often patent. Similarly with the highly concentrated fertilisers, tobacco may show various physiological disturbances in the field such as sulphur starvation (3).

It is now likely that one of the factors concerned in the incidence of a disease of tea in Nyasaland is a deficiency of sulphates in the soil. If this is so, it is not surprising that a fertiliser compounded with diammonphos, nitrate of potash, muriate of potash and urea has given very poor results with tea.

During both January and the latter part of the year, excessive rains were experienced in certain tobacco-growing areas. Applications of nitrogenous compounds such as sulphate of ammonia and nitrate of soda were made to tobacco in the field in such areas. Favourable results were generally obtained but it is desirable that the principles formulated some years ago which govern the correct time and method of application should be adhered to if quality is to be maintained (4).

5. CROP OBSERVATIONS.

During my continued visits to all parts of the country early in the year, my impressions of former years concerning the growth and ripening of tobacco were confirmed. Nyasaland could on these data be conveniently divided into tobacco zones. The question of type classification based on these tobacco zones was carefully gone into by a sub-committee of the Tobacco Association on which I served in November but it was not thought imperative to define numerous types at present but rather to draw, mainly for the information of the manufacturers, distinction between the Northern Province leaf and Southern Province leaf, whether fire-cured or flue-cured.

It may not be out of place on my part, however, to point out that the boundary between the two provinces does not demarcate exactly the dividing line between two main types of fire-cured nor does the use of such a dividing line mean that Southern Province flue-cured is indivisible into two or three distinct types. Each of these will be found most likely worthy of extensive study by means of field experiments and the use of a distinct variety which is kept true to type by careful plant selection and which will ensure a continuous supply from year to year of that type. The position in the latter respect seems from my observations to be very much improved of late years except that certain small localities seem to insist on growing varieties of diverse origin and uncertain breeding from year to year.

The question of seed for ensuring a good crop at once brings up that of disease, inroads of which present anxiety every year. The year's crop was particularly free from disease, drought-spotting in the Northern Province and frog-eye (caused by *Cercospora nicotianæ*) in the Southern Province causing the most damage. Mosaic, ring-spot and frencing were however frequently seen, but bacterial diseases such as angular leaf spot and hollow stalk were fortunately rare.

Drought-spotting is frequently referred to as "red rust" and, although a fungus is often found in association with the decayed areas, it is maintained that the fungus is merely saprophytic and that the disease is physiological. It has been seen in all parts of Nyasaland, but only under particular drought conditions. There were in many parts of the country, particularly in northern areas, excessive rains in January leading to poor root development, which led the growing plant to exhibit drought-spotting during the later dry period of February, March and April. The leaf surface was insufficiently fed by the root system which was either attenuated or incapable of absorbing certain elements which are necessary in leaf development. Drought spotting was seen most frequently on land which had been in tobacco cropping for some years or on the sandier types of soil. There is doubtless a correlation between drought-spotting and the supply of potash to the plant. The form in which the potash is supplied and its proportion to other soluble elements is also a factor in minimising damage to quality.

It seems to me from field observations that frog-eye is becoming a much more serious infestation on tobacco in Nyasaland especially in areas of higher rainfall or on soils of poor drainage. It is certain that varieties now grown for dark-fired leaf suffer much less. The question arises as to

whether they are less susceptible on account of longer acclimatisation and seed selection. I am also of the opinion that spraying the nurseries with Bordeaux mixture largely reduces the development of the disease. How far the disease, as with those of a bacterial origin, is seed-borne is worthy of study.

Damage to leaf for which a species of *Phyllosticta* is often held responsible has been seen. A virus disease known as *ring-spot* whose initial symptoms are somewhat similar leads to the breakdown of the tissue of the leaf. It is quite likely that the *Phyllosticta* fungus acts conjointly with the ring-spot virus causing whole portions of the leaf to rot and fall away to powder. Combination of the two diseases leads to a much more serious aspect of the problem.

The term *frenching* has been applied in Nyasaland for some years to plants with leaves which crinkle or curl, have shortened internodes and often exhibit foliar outgrowths on the underside. The extreme form has often been termed *cabbaging*. From the work of Dr. Storey of Amani, it is apparent that the disease commonly known here as frenching is different from that met with in the United States of America although a few isolated cases of the latter disease do occur. The former disease is most probably caused by a virus which can be transmitted by a white-fly.

I visited areas at the request of several native growers to investigate the loss caused by parasitic plants on cereals and leguminous plants. The former parasite was determined as *Striga lutea*, the common witchweed, and the latter was one of the *Orobanchaceae* and was a plant with little colouring matter which was closely allied in its characters with the broomrape. It was found particularly in the Lunzu and Likangala valleys. The necessity of rotations which include plants not attacked with the particular parasite concerned was impressed upon villagers. It is difficult to remove the latter parasite by hand as the roots are so intimately intertwined with the roots of the host plant, but better cultivation and a certain amount of cutting the flowering spikes of the parasite will reduce the damage to the host plant. The seeds are produced in great number and apparently are capable of retaining their viability in the soil for a few years.

In the absence of the Entomologist insect damage was noted and I assisted in the control of tobacco aphids with nicotine soap spray (2). Other crops under close observation during the year were tea and coffee. On the Zomba Plots a large number of crops was under trial for inclusion in cropping systems and as food crops for native gardens. They will be found listed in Appendix I.

The yield per acre of various crops on the Zomba Plots give some criterion of the season experienced. It must be conceded that the large amount of tobacco allowed to seed for native growers reduced the yield of leaf per acre of planted tobacco. From crop observations I prepared the monthly crop and market report issued by the department.

6. MISCELLANEOUS.

Routine work has included the supply of deci-normal iodine and starch gloy to veterinary officers, and the analysis of six stomachs of cattle to ascertain whether arsenical poisoning was the cause of death. One human stomach was also submitted for investigation of the cause of death. Three other substances were forwarded by the Director of Medical and Sanitary Services to find if poisons were present. Several samples of soap, water and fertilisers were analysed. I had to report on the supply of maize to the King's African Rifles, much of which I had to condemn.

Investigations were commenced into the manufacture of syrup and crude sugar from cane a mill for which is in operation in Zomba. The construction of a simple wooden mill for use in native villages is contemplated. Shoots of the *Uba* variety were issued in quantity from the plots.

A note may here be made about the nicotine content of Nyasaland tobacco. It is said that certain colonial tobaccos owe their mildness and good smoking properties to the small content of nicotine. Samples of Nyasa tobacco have been analysed since 1904 for nicotine and the content depends very much on the type grown and on factors in operation during ripening. The percentage found in dry leaf varies from 1.2 to 6.88, and it is obvious if there was distinct advantage in a very low content of nicotine for manufacturers, that it could be obtained by growing certain varieties. A point however often over-looked is that in tobacco with a low starch content the nitrogenous compounds are relatively increased in amount. How far this affects the aroma is an important point for manufacturers and growers in certain areas. It is doubtful if the nicotine content has as much influence on the aroma of tobacco as the content of resins and essential oils.

PUBLICATIONS.

I wrote an article on tobacco in Nyasaland for *Empire Production and Export*, the official journal of the British Empire Producers' Organisation. This embodied my views on the history and development of the industry, the correct methods of culture with the more important types of tobacco and the possible development of the future.

REFERENCES.

The following publications of the Department of Agriculture, Nyasaland, have been referred to by number in the report.

- (1) Dixey, Clements and Hornby, 1923. *Destruction of vegetation; its relation to climate, water supply and soil fertility*. Bulletin No. 1 of 1924.
- (2) Smee, C., 1923. *Tobacco extract (nicotine wash)*. Leaflet J, August 1923.
- (3) Hornby, 1926. *Tobacco culture*. Bulletin No. 1, page 60.
- (4) Hornby, 1927. *Notes on tobacco varieties in Nyasaland and their relation to fertilisers, etc.* Circular No. 1.
- (5) Hornby, 1924. *Soil survey of Nyasaland*. Bulletin No. 2 of 1924.

APPENDIX I.

List of introduced plants under trial or used for seed production on the Zomba Plots and in the Botanic Gardens, 1931.

<i>Adenanthera pavonina</i> . Red Sandalwood	<i>Indigofera endecaphylla</i> and <i>I. enneaphylla</i> .
<i>Aleurites Fordii</i> and <i>A. montana</i> . Tung oil	Ground covers
<i>Astragalus sinicus</i> .	<i>Leucaena glauca</i> . Shade and green manure
<i>Cajanus indicus</i> . Pigeon pea varieties	<i>Nephelium Litchi</i> . Litchi
<i>Calopogonium mucunoides</i> . Ground cover	<i>Mimosa pudica</i> . Sensitive plant
<i>Canavalia ensiformis</i> and <i>C. gladiata</i> . Jack bean	<i>Phaseolus lunatus</i> . "Lima bean
<i>Canna edule</i> . Edible Canna	<i>Phaseolus helvolus</i> . Ambérique
<i>Cassia hirsuta</i>	<i>Phaseolus vulgaris</i> . Kentucky and Canadian
<i>Ceratonium siliqua</i> . Locust or carob bean	Wonder bean.
<i>Coffea arabica</i> and <i>C. robusta</i>	<i>Phaseolus Mungo</i> . Mung bean
<i>Colocasia antiquorum</i> (<i>C. esculenta</i>). Root crop	<i>Schizolobium excelsum</i> . Shade tree
<i>Crotalaria anagyroides</i> . Green manure	<i>Schinus molle</i> . Pepper tree
<i>Crotalaria juncea</i> . Sunn hemp. Green manure	<i>Sorghum vulgare</i> and <i>S. saccharatum</i> . Varieties
<i>Crotalaria spectabilis</i> . Green manure	of Kaffir corn.
<i>Crotalaria usaramoensis</i> . Green manure	<i>Stizolobium niveum</i> . White-seeded Lyon velvet
<i>Desmodium gyroides</i> . Green manure	bean
<i>Desmodium tortuosum</i> . Florida beggar weed	<i>Stizolobium aterrinum</i> . Black velvet bean
<i>Digitaria Penzi</i> . Woolly finger grass	<i>Stizolobium deeringianum</i> . Florida velvet bean
<i>Dolichos hosei</i> . Cover plant	<i>Tephrosia candida</i> . <i>Boga medeloa</i> (Ceylon).
<i>Dolichos lablab</i> .	Green manure
<i>Eragopyrum esculentum</i> . Buckwheat	<i>Tephrosia Vogelii</i> . Fish bean. Green manure
<i>Gliricidia maculata</i> . Shade and green manure	<i>Xanthosoma sagittifolium</i> Tania. Root crop
<i>Glycine soja</i> . Soya bean varieties	

APPENDIX II

Yields from Zomba Plots in 1931.

	lb. acre
Maize	800
Wheat	675
Barley	348
Oats	1,540
Velvet beans	1,480
Pigeon pea	913
Sunn hemp	682
Seed cotton (<i>U4</i>)	248
Buckwheat	530
<i>Canavalia</i>	670
Soya bean	538
Sun flower	1,010
Upland rice	333
<i>Crotalaria usaramoensis</i>	142
Sorghum	384
Tobacco leaf	364
Tobacco seed	31½

There were also grown on the Zomba Plots or in the Botanic Gardens, cassava, banana varieties, Hubane and other clovers (including *Lespedeza*), lucerne, vetches, millets, Napier fodder, papaya, sweet potatoes, Tepary beans, Uba sugar cane, various fibre plants and palms. Wheat, barley and oats were grown by irrigation in the dry season.

The acreages are as follows:—

Plots: (1) tobacco and miscellaneous crops	28 acres
(2) Coffee, tea, tung oil, nurseries	7 acres
(3) fodder crops	5 acres
Botanic Gardens	60 acres
	100 acres

A. J. W. HORNBY

Assistant Director of Agriculture
and Agricultural Chemist.

Report of the Entomologist.

Leaving Nyasaland on January 21 I attended the conference of East African directors of agriculture held at Amani, Tanganyika Territory, from January 31 to February 7. At the conclusion of this conference I spent ten days in the Moshi and Arusha coffee districts, and on February 21 embarked at Mombasa for England. Separate reports on the conference and the visit to the Moshi district were submitted. While on leave in England I attended the conference of colonial directors of agriculture held at the Colonial Office from July 14 to 17. I resumed duty in Nyasaland on September 28.

Various matters were investigated during my period in England. The subject of the use of indigenous species of *Tephrosia* as insecticides was discussed with Dr. F. Tattersfield of Rothamsted, and seed samples of *Pyrethrum* were procured from the Ministry of Agriculture Pathological Laboratories, Harpenden, and from the Seal-Hayne Agricultural College, Devon. Visits were paid to the Parasite Laboratory, Farnham House, and to the Imperial Bureau of Agricultural Parasitology.

Particulars of a maize-drying plant were procured from Messrs. Thomas Robinson and Son of Rochdale whose considerable experience of these plants was extremely helpful and who provided, gratis, a very comprehensive specification and plan.

Through the courtesy of Messrs. John K. Gilliat I was enabled to attend auction sales of East African coffee and I obtained through the same firm valuable representative samples of South American, Javan and East African coffees of various descriptions.

LOCUSTS.

Discussion with Dr. B. P. Uvarov of the Imperial Institute of Entomology elicited the information that the locust situation in East Africa was extremely serious and that Nyasaland could scarcely hope to remain unassailed. Financial stringency dictated that a policy of mechanical destruction should be adopted rather than chemical poisoning, if locusts arrived. Although locusts have been swarming in North Eastern Rhodesia, in the Lake Bangweolu area since July 1931, the general tendency has been for the swarms to move in a westerly or south-westerly direction over the Congo border. This is extremely fortunate for Nyasaland but the menace of locust invasion has by no means passed. The type of locust in question, *Locusta migratorioides* R. and F., began swarming in West Africa in 1928 and appears to have followed a definite belt of vegetation, the savannah, right across the continent, finding subsidiary breeding areas around Lake Tchad and, later, the East African lakes. Consequently such areas as Lake Rukwa in Tanganyika Territory and Lakes Bangweolu and Meru in North Eastern Rhodesia must be looked upon as considerable sources of danger. Furthermore, river areas such as that of the Loangwa probably offer suitable egg-laying situations, if any swarms move in that direction.

TOBACCO.

Soft rot (? *Bacillus carotovorus* L. R. Jones).—The occurrence on a rather large scale of a bacterial disease which I assume to be the above on small plants soon after planting out caused some anxiety early in the season. The origin of the disease was difficult to locate, but by chance exactly the same symptoms were observed in the Zomba Experimental Plots among plants that had been pulled from nurseries and then badly replanted there, the roots being twisted and the stem and leaf stalks damaged. The plants were too small to show the "hollow stalk" effect that this bacterium produces in older plants, but the characteristic smell of *soft rot* was very noticeable.

It seems probable that this disease organism, extremely abundant and wide spread, is always responsible for a certain number of deaths of young plants if these are damaged at the time of planting, but that generally the plant is able to heal over any wounds, such as the base of leaf stalks, before the disease has penetrated any distance.

Cutworms.—An early attack of cutworm was experienced in the seedbeds of the Experimental Plots in Zomba, which resulted in a heavy infestation in the fields during the early part of December. There is an apparently widely-held belief that the use of kraal manure is conducive to extensive cutworm attack, but this is not correct.

The vexed question of "clean fields" prior to planting is one that always crops up in connection with cutworms, and so frequently does one hear it stated that A who keeps his fields spotlessly clean suffers severely from cutworm attack and B who does not pay so much attention to his fields never seems to get the pest that sometimes one is inclined to lend an ear to the argument that with unweeded fields the cutworms find other food than the tobacco plants. It is, however, a somewhat specious argument as it is almost impossible to compare, side by side, the two sets of conditions. The facts of the present season's outbreak at the Zomba Plots were that the nurseries were certainly more heavily infected in the first place than was realised. On November 9 cutworms of all ages were collected from the seedbeds, some just hatched from the egg and some just ready to pupate. A certain amount of hand-collecting was carried out and lead arsenate was incorporated in the weekly Bordeaux mixture spray but the thickness of the vegetation in the seedbeds prevented a full control being obtained, coupled with the fact mentioned that some of the

cutworms would have already become chrysalides in the ground. In captivity the first moths hatched on December 10, and it may reasonably be assumed that out of doors they had been hatching a good few days earlier. The seedbeds in question were, on account of spacing exigencies, to all intents and purposes in the middle of the fields, and it was very noticeable that, although the cutworms were collected from over practically the whole planted area, they were most severe in the areas nearest to the nurseries, the first to be planted. This planting took place on November 23, was followed by eight or nine days' dry weather, then rain fell and cutworms were very active from December 4-10, although the fields had been kept clean for a long period beforehand. The proposition is frequently put forward that the cutworm may be carried as such, or as eggs, on the plants taken from the nurseries to the fields. The cutworm moth lays its eggs singly on stones, sticks, bits of anything as well as on the plant and it is possible for these to be transported in small numbers in this way. It would seem unlikely, however, that the same would happen to the grubs themselves; if large they would scarcely escape notice and the small ones are more inclined to release their hold of a plant when disturbed than to remain clinging to it, but some might be overlooked. One of the factors controlling the hatching of cutworm moths is undoubtedly moisture, and a rainfall that is insufficient to permit planting to be carried out may bring out a large number of moths which disperse into the fields and elsewhere. On the other hand, if the first rain that falls is sufficient for planting, the setting out of tobacco plants and the emergence of cutworm moths will coincide. Theoretically, if the fields are clean there will be no inducement, in the first case mentioned above, for the moths to lay eggs there, but, as is known in practice, cutworm can be active in such fields at an early date. On considering a little more closely what happened at the Zomba Experimental Plots this season, however, it will be seen that there was an interval of approximately eleven days between the date of planting and the cutworm being noticeably bad. Although when collected the grubs were of varying sizes, it is probable that this period of time was sufficient to account for the size of most of the larger cutworms if at the time of planting eggs were present, and the smaller ones would have come from eggs laid by moths hatching from the nurseries after planting took place. It would be nice to think that if the fields were left uncleaned the cutworm would remain feeding on the weeds and take no notice of the tobacco. But there would not seem to be any guarantee that this would happen, and moreover there are other pests, such as surface beetles, as harmful to tobacco as cutworms, that would be harboured by the weeds.

TEA.

*Termites**.—The problem of white ants attacking young tea bushes still remains rather obscure. In certain areas of the Mlanje district the termite population seems to be enormous, while in parts of the Cholo district their numbers appear to be few enough to cause little or no trouble. The position is further complicated by the fact that, more often than not, several species of termites are to be found connected with attacked bushes. While one, or possibly two, species can be eliminated from being the cause of initial damage, there are at least two kinds on which suspicion must fall. The termites in question are of the type that make straggling underground nests with little or no surface indication so that any attack on them in that quarter seems out of the question. The termites appear to gain entry into the wood of the tea bushes through wounds and pruning cuts; in the latter case bushes have been found where attempts have obviously been made to eat away the cut end of a pruned shoot but for some unknown reason without success. On the other hand bushes that have not been pruned and that appear perfectly healthy to ordinary observation, have had the shoots cut clean off by the termites which have then entered the wood at this point. Although the species of termites (*Caloterme*s) which are such a serious menace to tea cultivation in some parts of Ceylon are not present apparently in Nyasaland, the damage done by the local types of termite would seem to warrant careful attention. The commonest kind of white ant in Nyasaland that attacks tea bushes is generally considered to be of a scavenging type that only devours diseased or unhealthy wood but from field observation it is at times hard to believe that some of the attacked bushes are suffering from any particular unhealthiness. In those areas where the white ant population is very great it may become necessary to consider the question of the treatment of pruning cuts and wounds.

Redheaded flea beetle (*Nisotra suahelorum* Weise).—In a few small patches in the Cholo district this little jumping beetle had completely destroyed the foliage of young tea plants. It is doubtful if this insect will attain a serious status, but being of a gregarious nature the damage done by it is likely to be concentrated in small areas. It is also likely to be met with on several kinds of leguminous cover crops, particularly some kinds of beans.

COFFEE.

White stemborer (*Anthores leuconotus* Pasc.).—In the last annual report it was pointed out that this stemborer would not die if the attacked bushes were merely uprooted and thrown away. It is of interest to record now that stemborer beetles have been bred in captivity from eggs laid on portions of coffee stems having no roots and no foliage, thus confirming the above statement in no uncertain manner.

FRUIT TREES.

Various insects damaging a variety of fruit trees have been submitted for identification. If interest is taken in fruit trees of any sort continual attention is required under local conditions as the number of insects attacking them, from the leaves to the fruits, is enormous, and spraying at regular intervals coupled with very careful cultivation are absolutely essential to ensure the production of a crop. On Mlanje plateau the fruits of nectarines have been seriously damaged by a brilliantly coloured beetle (*Colasposoma* sp.) and the leaves of apples and pears completely net-veined by an undetermined flea beetle (*Halticidae*); in the latter case an early application of lead arsenate would almost certainly have prevented the damage from being done. Elsewhere the peach fruit beetle (*Plaesiorrhina trivittata* Sch.) caused considerable damage to those fruits and to figs. An interesting case of an ant (*Myrmecaria*? *eumenoides* Gerst.) cutting off the leaves of young citrus trees was observed, the ant nest being at the base of the tree in question.

* The commonest species is probably *Acanthotermes militaris* Hagen.

MISCELLANEOUS.

A serious attack of millipedes on groundnut seedlings was reported in January from the Karonga district, and it seems that similar attack is occurring again now (December). Unless any form of trapping it under stones or pieces of wood can be devised, eradication of the pest seems to be very difficult.

A swarm of small black beetles with a reddish yellow patch at the apex of the wing-cases (*Exora apicipenne* Jac.) appeared in December in a certain corner of the Zomba Experimental Plots. The same beetle had appeared in enormous numbers in exactly the same area in December last year (1930) when considerable damage was done to sunn hemp. This year (1931) there was only a little sunn hemp just germinating at the time the beetles appeared, and although this was badly attacked as also was *Indigofera endecaphylla* in the vicinity, *nandolo* (*Cajanus indicus*) of which there was a considerable quantity readily available was practically untouched. In the previous year spraying with lead arsenate was carried out as the sunn hemp was large, but on this present occasion spraying was impracticable and the beetles were left undisturbed. Nevertheless in a week's time the swarm of beetles had almost entirely disappeared and only a few isolated individuals were to be found. This beetle should not be confused with a slightly larger black one with a red-brown head (some individuals being entirely of the latter colour) which is extremely common on all leguminous crops and frequently does considerable damage to them and to cotton. This latter beetle (*Ootheca mutabilis* Sahlb.) appears a little later in the year than the one mentioned above, has a much wider range of food plants and seems to remain prevalent for a considerable length of time. One of the big difficulties in establishing new ground cover-crops is likely to be found in the attacks on them by leaf-eating beetles such as the above and several others, which may prevent the seeding, and therefore the natural spread of, the cover crops.

On three occasions complaints have been received that small earthworms have been damaging young plants in flowerbeds. Although definite proof has not been obtained that the earthworms are really the cause of the damage it seems possible that they may be, and the following extract from *Farmers' Bulletin 1,569* of the United States Department of Agriculture may be of interest to those who have been troubled by these worms:—

“Often the soil of flowerpots and flower beds becomes overstocked with earthworms, and in many cases injury to the plants results. The worms are brought in with the soil or manure and under favourable conditions multiply rapidly. Their habit of tunneling through the fine root system is often damaging or destructive to cultivated plants. Limewater (saturated) applied freely to the soil will destroy earthworms and will not injure the plant. About two cupfuls of unslaked lime placed in a 3-gallon bucket of water, thoroughly agitated, and then allowed to settle, will furnish the desired clear liquid.

Tobacco dust thoroughly worked into the soil is effective and at the same time has some value as a fertilizer.

Drenching the soil with a weak solution of mercuric chloride (corrosive sublimate), as is recommended for use out of doors, will destroy the worms. It may be prepared by dissolving one-half ounce of this chemical in 4 gallons of water. The caution is repeated that as corrosive sublimate is a deadly poison, it should be stored and handled with extreme care.”

COLIN SMEE

Entomologist

Report of the Mycologist.

The work during the year has again been confined almost entirely to the investigation of tea yellows. The progress of this work is noted below; it has been gratifying to see the results of laboratory and field experiments correlating so closely. The diseases of tea which await further investigation are gnarled canker, violet root disease, *Armillaria* root disease and *Rhizoctonia bataticola* root disease. All these diseases are referred to briefly below. Now that the problem of elucidating the cause of tea yellows has been largely solved, it is hoped that considerably more time will be found available for experimental work on other diseases of tea.

Diseases of other cultivated plants have received only meagre attention and the work carried out on them has been largely confined to that of diagnosis. The District Agricultural Officers at Port Herald and Karonga have sent a few specimens of native crops suffering from certain fungous diseases. Experiments have been suggested to these officers with a view to controlling the diseases. There is abundant scope for investigation into the diseases of native crops, but as the Protectorate is subdivided into so many distinct climatic districts mycological work in connection with these crops will be of little value unless critical experiments for control measures are carried out under natural conditions. This can only be accomplished by collaborative work with the District Agricultural Officers such as has been started in a small way this year.

TEA.

Yellows.—The results of the work on this disease will be published in suitable form and made available to both planters and scientific workers so that only an outline of the results is mentioned here.

The cause of the disease is found to be due to a deficiency of available sulphate in the soil necessary for the healthy development of the tea bush. This deficiency produces the characteristic symptoms of yellows in the tea bush which were enumerated in last year's report. Specific symptoms are also found in other plants growing in affected soil.

From the work on tea yellows the physiological importance of sulphur to the green plant is shown clearly. The low available sulphate content of Nyasaland tea soils calls for an explanation from soil science because the main factors which have led to the deficiency have probably been effective in older tea-growing countries in the past. The role of sulphur in relation to plant growth has been under investigation for some years, especially by American workers. Their work has been largely related to the effect of sulphates on yield, although reference has been made to the general yellowing effect caused by lack of sufficient sulphate in certain crops, e.g., lucerne and tobacco.

The conclusion that sulphur deficiency is the cause of tea yellows has been reached as the result of close collaborative work with Dr. Storey, Plant Pathologist of the East African Agricultural Research Station, Amani. The work at Amani has been devoted principally to water culture and pot culture experiments, while the work in Nyasaland has been largely confined to field experiments.

The field work consisted primarily of keeping individual plants under observation from the start to the finish of several fertilizer experiments. Records were taken at various intervals throughout the year. Over 10,000 tea plants were subjected to close observation. The results of the fertilizer experiments substantiate fully the conclusions reached from the water culture experiments at Amani. These showed that the symptoms of tea yellows are obtained by growing tea seedlings in a full nutrient water culture solution minus sulphate.

The chief factors causing the deficiency in Nyasaland tea soils are those which induce soil deterioration. There is an exception in Mlanje where the disease is very troublesome on some soils which held heavy timber before the land was opened. All estates that have opened up tea gardens on this soil have had great difficulty in getting their plants established owing to the prevalence of yellows. Experiments on this soil show that the application of a sulphate fertilizer ensures the development of healthy plants.

Control measures for this disease are enumerated here: (1) the application of a sulphate fertilizer, i.e., ammonium sulphate, potassium sulphate, well-conserved kraal manure and very likely sulphur, although the latter has not yet had a sufficient trial to justify its recommendation; (2) the prevention of soil erosion by up-to-date methods; (3) the fixation of the sulphate of fertilizer added to the soil by the growth and subsequent digging in of green manure crops on fertilized areas; (4) the avoidance of forcing fertilizers which do not contain sulphate; these have been found to aggravate the disease.

Last year mention was made of the fact that a fungus, *Rhizoctonia bataticola*, was associated with every bush killed by yellows in the field. In view of the evidence collected which proves that yellows is due to sulphate deficiency, the conclusion which may be drawn with regard to the presence of the fungus is that it is present in these soils as a saprophyte. When the rootlets of a plant affected with yellows become sufficiently starved and weakened by the disease the fungus gains an entry. There has been some experimental evidence to uphold this view. There is little doubt that the reason that bushes in the last stage of the disease do not always react beneficially to the fertilizer treatment is that the fungus has obtained too strong a hold in the root system.

If the disease is combated along the lines suggested above it is confidently expected that the disease will be effectively eradicated from Nyasaland tea gardens.

The results show that sulphur as an essential element must not be disregarded in connection with the growth of plants under tropical conditions. The relation of sulphate deficiency to the growth of tropical plants other than tea needs investigation.

Gnarled canker.—This name is suggested as more appropriate for the disease previously known in this country as stem canker. The latter is not sufficiently distinctive, for stem canker in India and stem canker in Ceylon are different diseases, the one in India being similar to the Nyasaland disease.

Some nursery plants were cut back and planted after they had been under observation for a year. The stems which in many cases had died back to the canker in the dry season came away healthy.

When transplanting cankered plants from the same nursery into the field black lesions were found at the junction of the lateral roots. These lesions were found to be due to infection of the laterals by the fungus *Rhizoctonia bataticola*. The fungus is not always associated with this disease to such an extent. It is considered to have entered as a weak parasite into the roots impoverished by the canker which prohibited the normal translocation of reserves from the leaves to the roots. Although plants may be left in the nursery without pruning back the stem below the cankers until the time of transplanting, pruning below the canker is recommended some months before transplanting. This may give the plants time to build up fresh root reserves which will be of value to them in staving off a fatal attack by any weak parasite which may have gained an entry at the time when the plant was becoming weakened by the canker.

This disease occasionally causes trouble in the field but it is undoubtedly more serious in the nurseries. In the latter there seems to be a correlation between the incidence of the disease and certain soils. This is especially noticeable on the patches of black soil on the slopes near streams in the Cholo district. These soils are waterlogged during the wet season owing to springs. When choosing sites for nurseries planters should avoid similar areas.

Violet root disease.—The sporing stage of the fungus which causes this disease has been found. The fructification is visible as a flat velvety growth a few millimetres thick, girdling the stem and in some cases the lower branches and leaves a few inches from the ground. It is entirely superficial and does not enter the tissues of the stem. When dry this fungal mat is a dull yellow-brown colour; it readily absorbs water and turns nearly black. During the dry season the surface is sterile but at the start of the wet season when the moisture conditions are favourable the fungus starts to grow a new mat superimposed on that of the previous season. The first stage of the development of the fructification has not yet been noted. Before the production of spores commences the new growth shows up distinctly in purple patches with a faint brown tinge against the black background of the old tissues. Gradually these new patches become lighter in colour with the production of white (hyaline) spores until the surface is nearly white, at which time production is at a maximum.

The name of the fungus has not been fixed. The fungus appears to be more closely related to *Helicobasidium compactum* Boedijn which has been described on tea in Java than to *H. longisporum* Wakefield which was mentioned as the possible sporing stage of the disease in last year's report.

The sporing stage is rare in this country but its presence may complicate measures for controlling the disease, especially if it is found to be present on indigenous plants. It is considered that under Nyasaland conditions the sporing stage may be found to occur in thick damp undergrowth near streams. Control measures against infection by spores should aim at thinning as much as possible the indigenous vegetation surrounding the nurseries in order to prevent the production of fructifications in the immediate vicinity.

Control measures against this disease after it appears in the nurseries have proved very difficult as the plants show no sign of the disease until too late to apply soil disinfectants. The disease is generally so unevenly distributed through the nurseries that systematic trenching is not feasible. If, however, an isolated patch does occur in a nursery a trench is recommended round the affected area leaving a considerable margin of healthy plants which may be affected in the roots without showing signs of disease above ground. Apparently healthy plants when transplanted into the field with the fungus present in their roots died in most cases.

The disease appeared in one nursery in the early part of this year at the close of the wet season. Unlike the attacks recorded last year the plants continued to die even under favourable climatic conditions. The manager of the estate experimented with an application of lime after which the disease spread less rapidly. To what extent the lime was the cause of the reduced mortality cannot be judged correctly owing to lack of control areas without lime. Experiments will be carried out with regard to possible soil disinfection before planting up nurseries.

Some decaying roots of indigenous plants were dug up in the paths running between affected nursery beds. Fine threads of the fungus were found creeping over the roots of different species of plants, in most cases without entering the roots. This shows that in clearing nursery sites all the thicker roots within a workable distance should be removed.

Further search was made for the fungus in uncleared forest surrounding a nursery which was badly attacked last year. Threads were found on various living roots which were undoubtedly those of the fungus under discussion. Two or three plants of one species were found to have been killed by the fungus. The roots were dry and brittle and were covered with a purple mat of hyphae with distinct "infection cushions."

Armillaria root disease.—Although seldom causing extensive damage this disease is a constant source of trouble, especially on newly opened land. One estate carried out an extensive trenching programme which was recommended to deal with the disease in young tea. Unfortunately results have not been as satisfactory as was hoped in view of the considerable expense incurred in carrying out such a programme. The work has been a valuable indicator of the restricted use to which trenching can be put. The following points raised in connection with this disease may be of interest to those who wish to take steps against this root disease. There is no doubt that once an outbreak of the disease is allowed to get out of hand the disease can cause extensive damage.

The disease is more difficult to control in young tea than in old tea. This is probably due to the fact that in the latter case the roots of the original forest trees have in most cases decayed and left only the path of infection through the soil along the roots of affected tea. In young tea the roots of the indigenous hardwood trees take a few years to decay, with the result that during the first few years the main path of infection is by these roots and not by the infected tea roots. The control measures therefore should not be the same for both cases and the following suggestions are made to suit each case: (1) in both cases the affected plants must be dug out thoroughly including as many roots as possible; bushes have frequently been seen which have been dug out by severing merely the tap roots and leaving the larger laterals in the soil; (2) old tea gardens; the disease spreads slowly and may not appear to need any measure other than digging out the dying plants; the area of diseased patches gradually increases and it is round these that trenching is recommended; a margin of at least one row of healthy plants should be left inside the trenching; (3) young tea gardens; the main object should be to eradicate the slowly decaying indigenous roots as quickly as possible. Some roots are inevitably left in the soil during clearing. It is these roots which are a constant source of infection to the young tea until they are completely destroyed by desiccation. The best way to accomplish this seems to be as follows: (1) to search for the indigenous root which first caused infection to all diseased tea plants, which should be dug out and burnt, and to extricate as much as possible of the root by following its course through the soil in a horizontal direction, and (2) during deep hoeing operations to dig out any of the larger indigenous roots over one inch in diameter which may be encountered.

Rhizoctonia bataticola root disease.—The connection that this fungus has with root disease of tea in Nyasaland is of interest in view of the controversy over the question of the parasitism of this fungus. Apart from the reference to the infection of tea roots weakened by yellows, this fungus undoubtedly causes the death of tea plants more rapidly than the usual slow method seen in the case of yellows.

This year was again marked by a severe dry season. Some plants, notably those which had been somewhat heavily pruned, died suddenly after coming away well from pruning. All such plants had their roots extensively penetrated by this fungus. There is little doubt that the majority of these plants were suffering from yellows and were therefore weakened before the pruning. At the onset of the drought the extra strain put on the roots allowed the fungus to increase its activity beyond that to which it is normally confined in the case of yellows. Deaths could not be due entirely to drought as they occurred so sporadically and there was little difference between the root system of the dead plants and those still living.

One death however occurred in a plant which had been under observation during work on tea yellows. The plant had shown no sign of yellows and was apparently healthy when it was medium-heavily pruned. It came away healthy after pruning and then died suddenly at the start of the drought. It had a well developed root system which was penetrated throughout by the fungus. An interesting point is that the strain of *R. bataticola* which attacked this plant showed the characteristic black lines of *R. lamellifera* originally described by Dr. Small. The black lines have seldom been noted in roots killed by tea yellows. No plants have been observed killed by *R. bataticola* in this manner during the wet season. All the evidence collected so far seems to show that in tea in this country the parasitism of this fungus is dependent on a variety of factors which are unfavourable to the healthy growth of tea bushes, but there is no doubt that experimental work with the different forms at present known under the name of *R. bataticola* is required.

GREEN GRAM (*Phaseolus Mungo* Var.)

Brown leaf mould.—Specimens of the disease were received from the District Agricultural Officer at Karonga for identification. From the material received the following symptoms were noted. There were dark brown spots on the lower surface of the leaves. These spots were angular in shape due to being situated between the veins. They consisted of a velvety growth of a fungus closely related to *Heterosporium* sp. Microscopic examination showed that the parenchymatous tissues of the leaf were penetrated throughout by short round-celled hyphae of a light brown colour. The arrangement of the hyphae in the leaf corresponded closely to that of the cells of the spongy and palisade parenchyma. On the lower surface of the leaf small stromatal cushions were formed subepidermally. From each of the latter a tuft of about ten darker brown conidiophores arose the average length of which was 90 μ . They bore the conidia which were elongated, 1.5-septate, slightly constricted, light brown spores (average 34.45 by 7 μ). The fungus has been isolated in pure culture where it grows exceedingly slowly.

In the field the fungus manifests itself during the flowering stage of the host plant when it may cause marked defoliation. It has not been noticed on immature foliage. There seems to be no correlation between the incidence of disease and humidity or malnutrition, but there appears to be a slight correlation between the visitation of a sucking insect and also cool weather. The disease apparently affects the yield of seed considerably although there are no experimental results to prove this. It remains to be proved that the fungus is an active parasite.

CHINDUMBA (*Echinochloa frumentacei*)

Smut.—Specimens of diseased plants were received from Karonga. The organism which causes this disease was identified as *Ustilago Panici-frumentacei* Bref. from the description of that fungus in India. Specimens were sent to The Imperial Mycological Institute for confirmation and the interesting reply was received that the Nyasaland fungus appears to bear resemblances both to *U. Panici-frumentacei* and to *U. paradoxa* Syd. & Butl. with the suggestion that it may possibly be a hybrid. The specimens show swellings of plant tissue enclosing balls of black spores on the stems as well as in the inflorescences. In the latter the sori (swellings) arise in the place of a few individual grains.

Experiments were suggested to find whether seed disinfection may prove an effective control measure against the disease. Steeping the seed in 2 per cent. and 4 per cent. copper sulphate solutions for ten minutes with subsequent drying was recommended. These experiments will be carried out this season.

SORGHUM (*Sorghum vulgare*)

Grain smut.—Specimens were received for identification from Port Herald. The fungus which causes this disease is *Sphacelotheca Sorghi*. This identification was not sent to be confirmed at Kew. The disease is said to cause little damage in the Port Herald district, but experiments have been suggested to try disinfecting the seed with flowers of sulphur.

MISCELLANEOUS PLANTS.

The following diseases were identified:

Host	Fungus
Bulrush millet (<i>Pennisetum typhoideum</i>)	Smut <i>Tolyposporium penicillariae</i>
Lemon	Collar crack (<i>Armillaria</i>)
Peach	Leaf curl (<i>Taphrina deformans</i>)
Groundnut	Rosette (virus)
Mulberry scale insect	Entomogenous (<i>Fusarium</i> sp.)

R. LEACH
Mycologist

Report on the work of the Experimental Stations of the Empire Cotton Growing Corporation 1930-31.

MAKWAPALA.

Season.—The unfavourable distribution of rainfall during the past season has been the primary cause of a big drop in yields of almost every crop grown on the station. The previous season's good results were produced with a well-distributed fall of 82.71 inches. The season under review has had a total of 34.86 inches, just over 21 inches falling during the most important part of the growing season in January and February. Cultivation was impossible owing to excessive rains or intervening dull days, and the soil became saturated, causing yellowing and very poor root development. Rain ceased on April 20, and none has been recorded for over six months to date (September), a serious shortage of water is threatened in many parts of the country for tobacco nurseries and domestic use, and feed for cattle is poor.

General.—A mixed bulk of *U4* cotton grown last season yielded an average of nearly 600 lb. of seed cotton per acre. The yield this season has averaged 300 lb. per acre, 60 per cent. only being strictly No. 1 grade.

Planting conditions and stands were unusually good, and early growth satisfactory until the prolonged wet period set in when very little development took place and flowering was delayed until February 11. Red bollworm attack was rather serious during this period and a good deal of shedding occurred. There was a slight increase in flowering up to March 2 when a sudden heavy flush appeared which lasted 28 days and declined rapidly. This decline corresponded with a severe infestation of American bollworm which caused heavy shedding in addition to shedding caused by poor root systems and the rapid drying out of the soil.

Field Trials.—These were confined to a simple time-of-planting experiment. It has been fairly obvious that cotton must be planted with the first good rains at the station but the behaviour of *U4* elsewhere in the neighbourhood made it desirable to find out if the time of planting could be extended. The plots consisted of four series planted at ten-day intervals from December 12, five times replicated and randomised; continuous records were kept of flowering, fruiting and insect infestation. The results obtained were exaggerated this season. There is probably no significance between the two December plantings, but those for January dropped to one half and one tenth respectively of the December 12 planting. Results were very similar in a wide range of maize plots planted at weekly intervals over eight weeks.

Rotations.—Tobacco, maize, long term pulses (*Canavalia* and pigeon pea), sunn hemp (partly for seed, partly for green manure), groundnuts and various catch crops of beans were the principal crops grown in rotation.

The tobacco comprised a five-acre bulk of *Cash*, a bright variety for flue-curing, and five plots of approximately one acre each of selections from last season's *Western* types. The *Cash* grew too quickly and conditions were against it standing long enough in the field to produce good leaf. Early yellowing occurred and the cured leaf crops were of mixed quality and lacked body.

The *Western* plots were of considerable interest in the field. Four of them were of good appearance and type, but several off-type plants appeared in one plot.

Selfed single-plant selections and reselections have been made in both varieties for further trial, and a large number of leaf measurements recorded.

Maize yielded an average of 2,000 lb. per acre which is less than usual.

Pigeon pea being practically unaffected by the distribution of rainfall gave a good crop in its second year, though several trial plots of early maturing varieties planted this season almost failed and suffered badly from insect attack.

The uprooting of ground nuts by a simple potato digger attachment to Ransome's R. H. R. L. ridger was very satisfactory.

Soil Conditions.—Except in two corners where seepage occurs an improvement is being maintained in the much discussed soil conditions on the station. Ridge terracing is firmly and satisfactorily established and the reclaiming of eroded drains is making good progress. The grass planted throughout the building block has practically stopped any run off from that originally serious source of trouble.

The early cover of second year pigeon pea controls any serious movement of surface water during the rains, and the swelling of its penetrating and vigorous root system opens up the soil in a remarkable manner for good late ploughing. This season the crop has been planted as late as February, following tobacco, giving a small top crop, and cut back ready for the coming season.

One-way ploughing has been carried out and is strongly recommended to assist terracing and to correct the effect of ploughing in a circle which is a common method in this country.

A year's accumulation of 75 tons of farm yard manure is being applied at the rate of 5 tons an acre to land prepared for maize and dark tobacco.

W. L. MILLER
Acting Cotton Specialist.

DOMIRA BAY.

General.—A two-storied dwelling house with a garage and a general utility store have been built this year. At the time of writing they have not been quite finished but it is hoped that they will be before the rains begin.

Thirty acres of new land have been cleared but not stumped. Most of the clearing was done by Mr. Wakington of Chitala Estate, who took the wood in payment. The new land is very similar to that cleared last year, good in parts but suffering from waterlogging. It is quite typical of the surrounding country.

The water supply of the station is adequate but not very satisfactory. The water level in a well, dug last year near the bed of a dry stream, fell to under one foot by September, and deepening by a foot did not effect an increase in the depth of water. Water is obtained from holes dug in the bed of the stream and it is thought that the lack of water in the well is due to the difficulty of seeping through the brick lining which was laid in cement. The well near the house site has been taken down through rock which necessitated blasting to a depth of 65 feet and there are indications that water is not far off.

Season.—As will be seen from the rainfall diagram (not reproduced) most of the rain fell in January which was followed by a period of insufficient rainfall. The fields on the station are nearly level and there is little or no fear of erosion. But this very flatness is a disadvantage in times of heavy rainfall; as the surface drainage is slow the soil particles become deflocculated and the water seeps away so slowly that the area becomes virtually waterlogged. Extreme examples of this are found in the depressions in the fields and surrounding country where water may lie about as late as June. The new fields this year were particularly bad in this respect and for the latter half of January a large proportion of the thirty acres was under water. The result of this waterlogging when root development was taking place was to cause the roots to run along the ridges and in the subsequent dry weather the plants were unable to make much growth, many of them being stunted and bearing only three or four bolls or less. The whole of the new land was planted with bulk U4 and yielded an average of 297 lb. seed cotton per acre which cannot be considered bad under the circumstances. Some contour drains have been put in this year and it is hoped that the trouble will not recur. The labour supply was deficient and the weeds got the upper hand for a time, which probably contributed to the low yield.

The rest of the station was planted with small bulks and small plots. The yields for the small bulks were as follows:

<i>Cambodia</i>	134	lb. seed cotton per acre
<i>Over-the-top</i>	216	" " " " "
<i>U-4/2</i>	481	" " " " "
<i>U-4-4/2</i>	330	" " " " "
<i>U-4 (bulk)</i>	290	" " " " "

The three strains of U-4 in the above table were sown with seed sent from Barberton.

U-4 shows up very well in comparison with the other two varieties though this may be largely a seasonal effect. The comparative drought in February-March when the growth of cotton was almost at a standstill would favour a variety with a short growing period. Strain tests of the various U-4's will be planted this season.

The small plots consisted of a few selections from Barberton and a number from Makwapala some of which appeared promising. In addition some seed submitted for trial by Dr. Harland was planted but most of the plants appeared unsuited to their environment. Those that set seed will be planted again this season.

Insect pests.—Stainer was first seen in February but was not numerous until the middle of March when flowering was in full progress. The first and last pickings showed very little sign of staining. The bulk of the cotton had about 25 per cent. damaged cotton, mostly due to stainer and the rest due to boll worm.

Bi-weekly counts were made on the bulk *U-4* and the red, American and spiny boll worms were all found. The red boll worm was much the most common species and its greatest incidence was in April falling away in May and June. American and spiny boll worms were found sporadically in small numbers during the whole of the season. Sheddings due to boll worm were fairly constant through the season. Non-boll worm sheddings, always smaller in number, decreased from the middle of April onwards.

Jassid was present but not in sufficient numbers to do any visible harm. *U-4* showed considerable reddening of the leaves but did not appear to be affected in any other way. Some of the Makwapala selections were noticeably free in this respect. A few rows of jassid-susceptible *Foster-Whitehall-G.* were rather stunted but set quite a fair crop.

A few observation plots of *U-4*, *Cambodia* and *Over-the-top* were planted in the Lilongwe area. Owing to frosts which begin towards the end of May or early June earliness is of prime importance in this area and in this respect *U-4* has a decided advantage over *Cambodia* and to a lesser degree over *Over-the-top*. Some bulk selections have been made which will be planted on the Tobacco Board experimental plots this year together with some early selections made on the station.

Pests of all sorts were conspicuous by their absence, presumably due to the fact that cotton is not yet one of the normal crops in this district.

S. T. HOYLE

Asst. Cotton Specialist.

PORT HERALD.

Season.—The rainfall this season has been some 4 inches below normal. This slight shortage would not have made any appreciable difference had rainfall distribution been normal. In March, however, only 1.85 inches fell, instead of the usual 5 to 9 inches, and cotton planted in February and March gave a very poor yield in consequence. The 25 acres on the station were unfortunately planted in February and it is extremely doubtful whether the yield of No. 1 grade seed cotton will average 100 lb. to the acre. Picking commenced on August 31. Very light mid-season rainfall destroyed all hope of a second flush of flowers and consequent second crop.

Fortunately, from the lesson learnt last year, the native growers north of Port Herald, on the lighter land, were encouraged to plant early. Those who did so have already picked an excellent crop. Those who did not plant until mid February and March have had as poor a yield as the station has had.

After two such seasons as the last have been, one when only very early and very late plantings gave a crop and the other when only early planting succeeded, it is extremely doubtful whether any time-of-planting advice can be safely given to native growers. The safest appears to be that of planting as early as possible so that a second planting can be carried out if an early drought occurs. From past records an early drought appears to occur less frequently than a late one. No propaganda work on time of planting has so far been done in the district. Had it been done, and acted upon, the result this year would have been disastrous.

General.—Owing to the need for economy it was impossible to open the 10 acres of dimba land this year. Of the twenty $2\frac{1}{2}$ -acre fields on the station ten were planted with native food crops and ten with cotton. Only *U4* seed was planted.

Slightly over 2 tons of *U4* seed were distributed this season to 320 growers under the seed multiplication scheme with the reasonable expectation of receiving back some 20 tons of seed. Owing to the extremely poor yield (most of these gardens were planted during February and March) and to erroneous information that the cotton markets would be open for a short time only, resulting in a panicky sale of every sort of cotton as soon as buying started, it is feared that barely 10 tons will be recovered.

With regard to food crops an effort has been made to ascertain the most advantageous methods of intercropping, based on the belief that the native will be more readily induced to improve his garden through improved methods of interplanting than by adopting a system of rotation. Very little is yet known about intercropping in this country and this year's work was designed to gain some idea of the main problems to be tackled. Some useful pointers have been obtained and next season it is hoped that one or two outstanding problems may be tackled experimentally.

The yield from a $2\frac{1}{2}$ -acre field on the station has formed a useful seed stock of a small red-grained variety of maize, introduced to this country from British Honduras in 1928 by Mr. H. C. Sampson. The grain appears to be practically immune from insect attack and although the yield was not large it compared favourably with the native crop in the district which, on the same type of soil, failed entirely.

A small flock of native sheep was purchased locally early in the year. Hurdles have been made on the station and folding trials on various native crops will be carried out next season. Wethers and culled ewes find a ready sale in the Port Herald township where meat is scarce and difficult to obtain.

Field experiments.—A spacing experiment and a strain test were carried out this season. In the spacing experiment twelve different spacings were used, the layout adopted consisting of six random strips. The twelve spacings chosen were 6, 12, 18 and 24 inches in rows 3 feet and 4 feet apart, thinned to two plants per hole, 24 inches in 3 feet and 4 feet rows, unthinned and the usual native spacing of 3 feet by 3 feet, in scattered holes, both thinned and unthinned. Mr. R. S. Sennitt, General Manager of the Compagnie Cotonniere du Mozambique, suggested and worked out the details of the experiment with the writer and has carried out an exactly similar experiment, using the same sized plots (1/30 acre), at Nova Chupanga on the Zambesi River, approximately 50 miles due south of Port Herald. The writer's thanks are due to him for his very welcome advice and assistance.

Yields from the first, and it is feared the only, picking on the Port Herald Station suggest that the 18 and 24 inch spacing in 3 feet rows and the 3 feet by 3 feet native spacing, all thinned, may show some significant advantage over the other spacings.

The strain test included Gatooma U4 bulk, PU4/5-1, PU4/5-5 and PU4/5-12.

The layout consisted of six randomised blocks.

Yields from the first, and probably only, picking suggest that, as far as yield only goes, the strain PU4/5-12 is inferior to the other three, between which there is very little to choose.

Insect pests.—The effect of the rain shortage in March over-shadowed any insect damage; in any case there has been barely enough cotton on the station this season to make any insect's visit worth while. Sudan, American and spiny bollworms, stainer (*Dysdercus* and *Oxyerænus* spp.) and jassid have all been found on the cotton, but in small numbers, so small that no appreciable damage has been done.

Aphis attacked the *mapira* (*Sorghum vulgare*) and did considerable harm but the cotton escaped damage. Minor pests on cotton this season were two Pentatomid bugs, *Callidea dregei* Germ. and *Sphærocoris annulus* F., a Noctuid moth, *Egybolis vaillantina* Stoll. and an Arctiid moth unidentified. A Pyralid moth, *Chilo* sp., did tremendous damage to the *mapira* crop on the station and throughout the Lower River, boring into the stem just below the developing head which is later attacked and partially or wholly destroyed. Partial control at least would appear to lie in complete destruction of stems after harvest. This is unfortunately against native custom, the stems being usually left until the following November (the crop is harvested in May and June) when fire is put through the whole garden. Natives throughout the district have been advised to destroy the stems directly after harvest and many have done so this year. This stem borer also attacks maize. A Curculionid weevil, *Cylas compressus* Hartm., together with a millipede, did considerable damage to the sweet potato crop in the field.

Machewere (*Pennisetum typhoideum*) was attacked by a smut fungus (*Tolyposporium penicillariæ*) and *mapira* by another species of smut (*Sphacelotheca Sorghi*); the latter attack was bad.

E. LAWRENCE

District Agricultural Officer.

EUROPEAN AGRICULTURE.

Name of district.	Total acreage under cultivation. acres.	TOBACCO		TEA		SISAL FIRRE		COTTON.		COFFEE.		RUBBER.		CHILLIES AND CAPSICUMS.	
		Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt. (lint)	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.
Lower Shire	6,840	...	...	...	...	6,724	3,060	25	10	...	...	...	...	...	...
Chikwawa	75	20	...	...	...	...	...	5	4	...	...	...	...	...	...
Central Shire	382	207	428	...	...	...	...	...	...	...	...	...	...	...	...
Cholo	15,948	4,044	12,085	3,137	1,243	2,560	...	...	...	315	18	...	...	...	...
Mlanje	11,651	967	1,815	8,287	18,340	...	...	...	...	362	76	...	...	8	10
Blantyre	5,139	1,152	3,565	...	...	...	...	...	...	364	336	...	...	4	2
Chiradzulu	3,338	624	1,462	...	...	...	...	60	...	...	...	...	...	...	...
Zomba	4,349	1,619	2,985	...	...	20	...	27	32	2	...	...	...	...	...
Upper Shire	153	82	274	...	...	...	...	5	...	...	...	...	...	...	...
South Nyasa	1,812	1,337	4,300	...	...	...	...	...	...	17	4	...	...	...	...
Ncheu	1,960	1,409	3,870	...	...	...	...	...	...	260	409	...	...	...	...
Dedza	498	220	745	...	...	...	...	6	4	19	8	...	...	...	...
Fort Manning	202	125	510	...	...	...	...	...	...	2	2	...	...	...	...
Lilongwe	1,667	1,232	3,992	...	...	...	...	...	...	...	...	...	...	...	...
Dowa	834	432	1,166	...	...	...	...	60	50	...	...	...	...	...	...
Kota Kota	25	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Kasungu	14	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mombera	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...
West Nyasa	1,509	...	...	...	...	...	...	...	...	...	...	1,500	...	...	...
North Nyasa	349	12	22	...	...	...	...	37	59	201	122	...	...	...	...
Total	56,755	13,482	37,219	11,414	19,583	9,304	3,050	225	159	1,542	1,175	1,500	...	12	12

EUROPEAN AGRICULTURE CONTINUED.

Name of district	MAIZE AND MILLETS.		BEANS.		GROUNDNUTS.		WHEAT.		POTATOES.	MISCELLANEOUS.	TIMBER AND FIREWOOD	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.
	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Acres under crop.	Yield cwt.	Eucalyptus acres.	Other trees acres.					
Lower Shire ...	45	308	13	40	2	8	...	...	...	...	18	8	...	...	...	...	...
Chikwawa ...	30	15	...	...	...	...	...	...	...	...	...	15	...	...	...	...	...
Central Shire ...	25	250	...	...	...	...	...	...	...	...	40	55	...	...	...	...	...
Cholo ...	451	5,631	713	1,449	8	5	14	18	1	50	4,185	321	...	...	...	...	...
Mlanje ...	443	5,000	270	1,073	30	150	...	...	...	...	818	444	...	...	...	...	...
Blantyre ...	554	6,584	131	227	2	10	9	10	...	...	2,394	246	...	...	...	...	...
Chiradzulu ...	443	4,910	79	129	...	...	2	...	...	...	1,850	110	...	...	...	...	...
Zomba ...	942	11,631	282	1,057	12	71	...	...	1	27	897	308	...	...	...	...	...
Upper Shire ...	20	100	5	80	4	5	...	...	...	...	5	2	...	...	...	...	...
South Nyasa ...	9	36	19	78	...	...	1	4	...	...	145	244	...	...	...	...	...
Nchen ...	36	270	...	...	...	...	...	...	...	...	27	81	...	...	...	...	...
Dedza ...	9	85	11	41	...	...	12	...	18	400	85	54	...	...	...	...	...
Fort Manning ...	6	153	13	122	4	40	23	147	...	...	4	25	...	...	...	...	...
Lilongwe ...	8	64	...	...	...	...	...	...	2	20	76	314	...	...	...	...	...
Dowa ...	167	625	30	23	...	...	21	129	...	...	17	83	...	...	...	...	...
Kota Kota ...	...	...	1	3	...	...	5	25	2	2	7	10	...	...	...	...	...
Kasungu ...	7	40	5	5	...	...	...	...	2	9	...	...	...	...	...	...	...
Mombasa ...	...	...	...	...	...	...	...	...	...	...	...	10	...	...	...	...	...
West Nyasa ...	...	...	...	...	...	...	...	...	...	...	4	5	...	...	...	...	...
North Nyasa ...	58	692	8	43	3	50	5	15	...	...	4	19	...	...	...	...	...
Total	3,193	36,544	1,550	4,410	63	339	92	438	26	488	10,606	2,354	...	...	...	...	...

NATIVE AGRICULTURE.

District.	Seed cotton.	Tobacco.		
		Production.	Registered number of growers.	
			Private estates.	Crown land.
	Tons.	Tons.		
Lower Shire	1,126	—	—	—
Chikwawa	1,040	—	—	—
Central Shire	199	—	—	—
Cholo	—	24	225	71
Mlanje	3	218	132	3,453
Blantyre	22	83	612	525
Chiradzulu	—	276	1,970	5,275
Zomba	—	111	3,428	1,011
Upper Shire	—	½	13	373
South Nyasa	3	—	12	—
Ncheu	17	52	39	830
Dedza	26	118	—	1,478
Fort Manning	—	88	333	330
Lilongwe	—	1,600½	1,164	16,562
Dowa	41	780	1,114	9,738
Kota Kota	—	168	—	2,652
Kasungu	—	—	—	563
Mombera	—	—	—	—
West Nyasa	—	—	—	—
North Nyasa	—	—	—	—
Total	2,477	3,519	9,042	42,861

NOTE.—Maize is the staple foodstuff in most districts; groundnuts, rice, wheat, beans, and various other crops are also grown by natives for local consumption, but it is impossible to make an accurate estimate of the quantities of any of these crops.

The above tobacco figures represent the quantities purchased in each district, and do not accurately reflect the production by districts, as many natives grow their tobacco in one district and sell in another.

NATIVE LIVE STOCK.

District.	Cattle.	Sheep.	Goats.	Pigs.
Lower Shire	68	1,380	9,160	3,000
Chikwawa	171	156	976	2,000
Central Shire	716	674	3,539	3,468
Cholo	150	605	2,431	5,981
Mlanje	95	750	4,200	2,750
Blantyre	1,157	1,078	5,870	5,694
Chiradzulu	1,261	607	4,361	4,803
Zomba	952	659	958	213
Upper Shire	49	4,136	8,793	370
South Nyasa	1,121	11,978	14,129	49
Ncheu	11,640	4,417	27,160	6,666
Dedza	18,854	16,275	28,350	9,975
Fort Manning	1,358	3,303	8,395	3,904
Lilongwe	18,381	14,000	38,000	4,000
Dowa	18,970	16,474	36,285	13,967
Kota Kota	2,509	3,325	7,916	2,178
Kasungu	3,656	4,300	3,100	8
Mombera	37,065	7,100	15,095	40
West Nyasa	3,500	320	2,000	—
North Nyasa	33,653	970	3,650	42
Total	155,326	92,507	224,368	69,108

LIVE STOCK OWNED BY EUROPEANS AT 31ST DECEMBER.

District.	Cows and heifers over one year.	Bulls.	Oxen.	Calves.	Pedigree cattle.	Horses.	Mules.	Donkeys.	Sheep.	Goats.	Pigs
Lower Shire	...	18	670	568	2	...	...	1	77	61	67
Chikwawa	...	8	51	126	...	...	...	15	8	...	...
Central Shire	...	4	40	12	...	...	...	2	24	45	3
Cholo	...	40	1,412	822	18	1	...	26	202	31	191
Mlanje	...	31	897	456	...	...	...	1	215	30	117
Blantyre	...	23	1,014	476	25	3	...	17	32	27	100
Chiradzulu	...	6	577	351	8	...	...	21	62	...	67
Zomba	...	22	1,043	381	9	1	...	16	426	23	39
Upper Shire	...	1	4	9	...	...	...	...	25	88	28
South Nyasa	...	4	66	38	...	...	...	...	96	139	...
Ncheu	...	7	201	141	5	...	...	...	52	78	138
Dedza	...	17	261	172	...	...	...	69	150	178	175
Fort Manning	...	1	64	24	...	...	...	14	33	...	14
Lilongwe	...	6	292	113	...	...	...	14	36	37	96
Dowa	...	2	99	62	...	...	...	11	217	14	62
Kota Kota	...	2	16	26	...	...	...	5	36	...	3
Kasungu	...	...	...	...	...	...	...	...	16	...	...
Mombera	...	2	3	6	...	...	...	4	...	...	...
West Nyasa	...	1	11	5	...	...	...	...	41	...	15
North Nyasa	...	10	197	61	...	...	...	4	141	10	40
Total	8,771	205	6,918	3,849	67	5	...	220	1,889	761	1,156

An Analysis of the cost of the Native Tobacco Board in 1931.

RECEIPTS.			PAYMENTS.		
Balance brought forward from 1930.			PERSONAL EMOLUMENTS.		
	£	s. d.		£	s. d.
	10,892	17 2	European staff ...	6,093	16 8
			Native staff ...	2,180	0 6
REVENUE 1931.			Total ...		£ s. d.
Tobacco tax	8,524	15 0			8,273 17 2
Sale of tobacco seed to natives ...	1,982	2 0	OTHER CHARGES		
Sale of tobacco seed to Europeans ...	224	10 10	Travelling ...	1,673	16 9
Sale of tobacco leaf	105	15 7	Passages ...	120	18 2
Sale of miscellaneous seeds ...	12	10 2	Experimental plots	204	18 6
Sale of fertilizers	6	0 0	Buildings-Likuni	1	18 3
Miscellaneous receipts ...	7	13 3	Buildings-Agent's house, building of	17	8 0
Interest on fixed deposits ...	145	0 0	Buildings-Agent's house, repairs ...	20	2 1
			Stationery and printing ...	105	12 3
			Implements and tools ...	1	17 6
	11,008	6 10	Bush cars ...	47	7 5
			Pedal cycles ...	90	0 0
			Tobacco seed ...	279	0 0
			Uniforms ...	2	5 8
			Incidentals ...	38	16 7
			Total ...	2,604	1 2
			CONTRIBUTIONS		
			Forestry ...	179	12 9
			Roads ...	130	3 8
			Experimental work, Zomba		
			Experimental Station ...	269	4 9
			Total ...	579	1 2
			CENTRAL BUYING STATIONS		
			Permanent station hands ...	35	5 9
			Police ...	42	0 0
			Erection and enlargement of	525	11 9
			Total ...	602	17 6
			Total expenditure	12,059	17 0
			Advances ...	185	13 4
			Total payments ...	12,245	10 4
			BALANCE CARRIED FORWARD TO 1932		
			Treasury ...	1,021	14 11
			Current account ...	1,633	18 9
			Fixed deposits ...	7,000	0 0
			Total balance carried forward to 1932 ...	9,655	13 8
	£21,901	4 0		£21,901	4 0

